MEETING ON INFORMATION TECHNOLOGY POLICIES FOR SMALL AND MEDIUM ENTERPRISES IN LATIN AMERICA AND THE CARIBBEAN

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International Development Research Centre

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Issues for Policy Research

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INTRODUCTORY PAPERS

Document 01

Improving the Information Technology Policy Environment in Latin America and the Caribbean: Report of Meeting, Montevideo, April 1-3, 1993

Fay Durrant, Regional Program Officer, IDRC, Montevideo

Introduction

In the past three to five years there has been a significant increase in the availability of information technology in Latin America and the Caribbean, and some consequent changes in the infrastructure of some organizations and of some countries. These changes have also been the result of a number of influences, including the globalization and liberalization of import and trade policies and consequently increased access to markets, the development of local manufacturing capabilities, the recognition of the potential role of information technologies in management and organization of processes, the proactive role of information technology suppliers, and technology transfer by these suppliers.

These developments are requiring policy makers and managers to make choices and to formulate policies which are expected to facilitate access to information, to technologies, and to technological know-how. The difficulties experienced are related to the need to determine and identify the appropriate information technologies for specific purposes, to have the capacity to install and use these technologies, and to develop the capacity to formulate policies which can remove the constraints in the implementation of appropriate information technologies.

A meeting held to review the situation and to identify research issues brought together five researchers and informatics practitioners from the fields of information technology policy: Briquet de Lemos formerly of IBICT and the University of Brasilia; Enzo Molino, Chief of Informatics, Electricity Corporation (Mexico); Carlos Correa, Director of the Master's Program, Centre for Advanced Studies, University of Buenos Aires and a researcher in information technology policies; Norman Girvan, Director, Consortium Graduate School of the Social Sciences, University of the West Indies and a researcher in technology policy; and more recently in information technology policy; and Luis Soto Krebs, a specialist in technology change, formerly of the UNIDO office for Argentina and Uruguay.

The general objective of the meeting was to review information technology policy issues which are expected to impact on the regional development agenda, and to determine an appropriate modus operandi for the development of a program on Information Technology

Policy Research for IDRC in Latin America and the Caribbean.

As ***IDRC's Corporate Program Framework 1993-1996*** lays out priorities for sharpening the Centre's focus for program delivery and for reinforcing the role IDRC plays as a lead organization in AGENDA 21, it provides a framework for all programs including the program for ***Information Technology Policy Research*** and the consequent regional initiatives. For Latin America and the Caribbean, the Corporate Program Framework identifies the particular regional initiative which will focus on the potential role of information technology policies in facilitating access by regional actors to information, to information technologies and to technological know-how.

The program for ***Information Technology Policy Research*** will include support to:

information technology policies and policy instruments (informatics and telecommunications policies);

social, economic and political impact studies dealing with the introduction, transfer and use of information technologies in the region;

information technology evaluation methods;

regional inventories of information technology policies; and

financing of information technology research.

An important objective of the meeting held in April was therefore the validation, for the program for Information Technology Policy Research, of priority issues for Latin America and the Caribbean.

In the context of the program, the term "information technologies " is taken to mean primarily "***electronic-based technologies which can be used to collect, store, process, package and communicate information, and provide access to knowledge***". The emphasis will be on technologies which are "informatics compatible", that is those which can be integrated with computing capacity to provide for assisted information and knowledge processing.

The deliberations of the meeting examined major issues of regional concern and the factors impacting on information technology policy formulation. The participants also sought to examine the priority areas requiring further analysis in the context of developments in Latin America and the Caribbean, and to identify research design methodologies for follow-up action to be supported by IDRC.

The scope of information technology

While there has been a rapid and continuous evolution and integration of information technologies the main elements can be categorized as:

HARDWARE - ranging from large-scale mainframe computers to small-scale microcomputers

SOFTWARE - ranging from traditional languages such as COBOL and their fourth-generation equivalents to expert systems that have emerged from developments in artificial intelligence

NETWORKS - telecommunications networks ranging from public to private, and from broadband to narrow band

WORK STATIONS - combining hardware and software and telecommunications capabilities, and ranging from those designed for engineers, with large computational capabilities and the ability to display dynamic, three-dimensional colour graphics, to professional workstations used by bank lending officers, market analysts, or consumer goods companies. They often rely on models, heuristics and simple graphics and often have very large databases included in the system

ROBOTICS - these range from robots with "vision" and "hands" used in the factory floor to a variety of devices such as automatic teller machines;

SMART CHIPS - "Intelligent chips" are used in products to enhance functionality or reliability.

Source: Scott Morton ed. The Corporation of the 1990's : IT and organizational transformation.

The development of information technologies more than other technological areas is characterized by rapid changes in the technologies themselves, as well as in the means of adoption, implementation and exploitation.

Changes in the region

Changes in the region have been very uneven with significant developments in some "advanced" countries' organizations and in the urban areas. There have been some externally influenced developments such as access to electronic mail networks; particularly, access to BITNET & Internet. Other changes have been driven by the commercial sector, such as access to personal computers, or by national informatics policies as in the cases of Brazil, Argentina & Mexico.

These influences have been very uneven and often not guided by policies; in fact, the incorporation of information technologies can be described as uncontrollable and as being driven by a combination of forces - particularly technology push.

In recognition of the fact that the continuing reality of the information society is that the life span of particular instruments of government will be limited [Rosell et al 1992] the meeting considered the need to identify methodologies for policy formulation and proactive responses to the further development and implementation of appropriate information technologies in organizations in the region.

The organizational environments in the region are rapidly changing as a result of various social, political, economic and technical influences. The meeting considered that the main changes in the organizational environments in Latin America and the Caribbean are resulting from the following influences:

Democratization of governments

Most countries in Latin America have established democratic governments and have identified the development of more democratic, open information systems as priorities. There is also evident an increasing participation of the non-government sectors - the private sector and NGOs in policy formulation and implementation.

Downsizing by governments

Government downsizing and privatization of public enterprises is a process which is being implemented throughout the region, and which is encouraging the development of more entrepreneurial activities than would have been the case under earlier regimes of monopolized markets.

Decentralization of organizations

The trend toward decentralization of public and private organizations is affecting the way in which organizational structures function, and also the type of information technology infrastructure required for linking the organizational components and for carrying out joint functions among separate units. The development of regional development programs and of institutions within municipal and provincial governments are widely identified as priorities throughout the region.

Trade liberalization

Sub-regional integration initiatives such as NAFTA and the MERCOSUR are supporting the

establishment of trading blocks and encouraging the opening up of markets and consequently the liberalization of trade in the region. While the results of the Uruguay Round are as yet inconclusive, the trends toward openness of markets and the production of software outside the organization are resulting in increased international market linkages, and liberalization of the access from outside the region to local markets.

Access to information technologies

One of the results of the current situation and particularly of wider market access, is that the supply of basic information technologies presently outweighs demand, and often outweighs the capacities of users to employ these technologies. Automated process, data entry and order entry systems are being used in government and private enterprises as substitutes for clerical accounting and managements tasks, but the examples of the integration of information technologies into production processes or into other areas of "knowledge work" were considered by the meeting to be still at very initial stages. The meeting considered that there is presently inadequate capacity to develop and use advanced information technologies such as production and process control systems or robotics.

Indigenous products

The uncontrolled invasion of some information technology products and services, the reduction and opening up of formerly protected local markets, and the tendency toward outsourcing can also have a negative impact on the development of indigenous products in all fields, including information technology products and services.

Standards and compatibility

While standardization of information technology products and services would not be practicable or desirable, the present situation of inadequate interconnections and incompatibility of systems, identifies the need for policies which encourage interconnections, electronic data exchange, and other integrations which are now a characteristic of information technology systems.

Research modalities

In recognition of the role of multiple stakeholders in policy formulation and implementation, there is also an increased need for implementation of participatory research and development activities. In this context such research activities would be expected to be incorporated along with researchers, the private sector, NGOs and government agencies in the implementation of information technology policy research, and is therefore seen as a necessary trend in regional research.

Information technology has generally shown signs of having unexplored potential for creating multi-faceted sources of information, for automating organizations, for coordinating processes, and for stimulating organizational change. Research on the capacity of information technology to improve productivity is, however, not conclusive.

Policies and policy-making

Hamelink (1988:46) in his analysis of informatics policies concludes that "in the area of informatics policy-making, many countries have developed only fragmented initiatives steered by myopic interests and technological opportunities." While he identifies three relevant levels of public policy : **strategic choice, tactical choice** and **operational choice,** he also concludes that much policy-making in the area of information technologies has been at the operational level.

The choices as classified below seem most aptly related to the **NATIONAL, ORGANIZATIONAL, AND OPERATIONAL LEVELS :**

STRATEGIC CHOICE ***at the national or regional levels***

Choice relating to conditions for information technology development, choice for the level of technology, degree of commitment in a society, and direction of technological development.

TACTICAL CHOICE ***at the management levels of organizations*** or firm levels

Choice related to the desirability of certain technological innovations - measures to implement strategic choices - which can be reflected in policies related to:

regulations,
incentive schemes,
procurement plans,
treatment of foreign manufacturers,
guidelines for data security,
criteria for selection of information technology firms,
subsidies to information technology producers,
conversion from analog to digital, and
network topologies.

OPERATIONAL CHOICE ***within organizations or firms***

Choice which tends to address the operational level as related to modes of acquisition and actual usage, the day-to-day decisions of management, and the impact of information technologies.

Problem statement

It was recognized by the meeting that information technologies are a set of enabling technologies which can have widespread application across all sectors, but which have particular potential for improving organizational productivity and competitiveness. They also have significant unexploited potential at the community level. Appropriate adoption, adaptation, transfer and use of information technologies can only take place with informed

choices and the development of user capabilities. Effective implementation therefore requires active involvement of user organizations in the identification of problems or barriers to information technologies selection, adoption, transfer and use, and the definition of channels for overcoming policy challenges.

The information technology situation in Latin America and the Caribbean was found to suffer from uneven development, in terms of demand for certain levels of information technology, such as personal computers, and accounting systems etc. Telecommunications infrastructure, or the more sophisticated automated systems for process control are not readily available. The meeting agreed that, while there are several areas for appropriate focus for the program, an important one would be the small and medium sized enterprises (SMEs) and organizations, as the key agents for increasing productivity, and for stimulating competitiveness in the region.

Issues of information technology policy could therefore be examined further in relation to regional concerns which are expected to have important impacts on SMEs, and on information technology policies.

Program areas

The following areas will be therefore analyzed in terms of the problems faced by SMEs and the global and regional trends in information technologies.

The analysis will cover the main areas of:

access to information technologies,

management and organization of information technologies, and

human resources development.

These areas would need to be analyzed in terms of :

Effectiveness of policy-making related to information technologies as influenced by:

decentralization of governments and organizations,
potential impact on organizational productivity and competitiveness,
environmental issues in the use of information technologies, and
democracy and empowerment practices.

Facilitating factors or constraints in the introduction of information technologies:

standards and compatibility - protocols etc.,
relationships with larger clients,
role of Intermediaries - Industry Associations etc.,
reliability of telecommunications infrastructure, and

availability of financing.

Policies and strategies for removing bottlenecks in the acquisition and implementation of appropriate information technologies.

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IDRC

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Document 02

Improving the Information Technology Policy Environment in Latin America and the Caribbean: Aide-Memoire

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As part of the process of implementing its Corporate Program Framework 1993-1996, IDRC is presently defining a regional program for Information Technology Policy Research.

The objectives of this meeting are to assist IDRC in:

- providing a regional forum for discussion of information technology policy issues as they relate to SMEs;
- analyzing the results of a set of studies which have been commissioned for the meeting, and which aim to identify regional requirements for Information Technology Policy Research;
- determining areas where effective information technology policies exist for stimulating the development of SMEs in the region;
- defining research required in the formulation and implementation of information technology policies in relation to SMEs; and
- identifying areas and issues to be considered for support in IDRC's Information Technology Policy Research Program.

The first stage of the discussions took the form of a meeting, of researchers and practitioners, held in Montevideo from April 1-3, 1993, and those discussions are to be continued by the meeting scheduled for December 6-8 of this year.

The report of the April meeting on Improving the Information Technology Policy Environment, summarizes the conclusions reached in April, and provides a framework for further definition of the scope of information technology, and for IDRC's program of Information Technology Policy Research.

The study areas which were identified by the meeting held in April, are considered as providing the basis for determining the effectiveness of existing information policies, as well as the areas in which subsequent research could be expected to contribute to effective information technology policy formulation.

The analyses which will be undertaken will cover the situation in Latin America and the Caribbean in the areas of:

- SMEs and technology change;
- access to information technologies;
- management and organization of information technologies; and
- human resources development and information technology policies.

Participants of the meeting will be policy makers, representatives of small business support organizations, and regional and Canadian researchers, and each participant will be invited to make a presentation of not more than three minutes.

It is expected that all those participating in the meeting will bring their experience to bear on the questions and issues discussed, in order to identify:

- current and future requirements for information technology policy formulation;
- areas where information technology policy research is required in Latin America and the Caribbean; and
- where the opportunities exist for appropriate Canadian - Latin American cooperation.

A draft agenda is attached and a detailed agenda will be sent to you in advance of the meeting.

I certainly hope that you will be able to participate in this meeting, as I consider that your contribution will provide a valuable input to the outcome of this exercise.

Yours sincerely

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SUBMITTED PAPERS

Document 03

New Technology Monitoring Project

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New Technology Monitoring Project

The New Technology Monitoring Project is financed jointly by the European Economic Community and the Simón Bolívar Andean University. It was started towards the end of 1991 and its first stage will extend to the end of 1994. The project's main objective is to provide links between European and Andean scientific communities and among the Andean business communities. The financial support of the European Economic Community for this first stage of the project amounts to approximately 4.5 million dollars, while the Simón Bolívar Andean University's contribution is 1.5 million dollars.

Principal project activities

The New Technology Monitoring Project is, in this first stage, strengthening the infrastructure which will allow good data communication among Andean countries and between these countries and Europe, as well as the establishment of information centres based on the installation of CD-ROM readers. Furthermore, courses and seminars are being organized in four top-priority scientific and technological areas: biotechnology, renewable energy, new materials, and information technology.

Programs aimed at small and medium enterprises

Active European participation in Andean scientific and technological presentations

For this purpose, the project will use fairs, seminars and conferences to disseminate European information and technology and promote networking among the scientific and technological communities of Andean countries.

Technology transfer activities linked to the development of Andean countries, based on their priorities

A great effort is being made, through the project, to sensitize the principal actors in the economic development of Andean countries in order to allow a real technology transfer with European countries. Specific technology transfers will take place particularly in top-priority designated fields: agriculture, health, the textile industry, the metallurgical

industry, mining, new materials and environment. These activities will bring together a large number of Andean and European specialists in specific subjects. These events will be open to participants from other countries too, in order to establish the conditions for the greatest possible exchange of information and technology.

Access to information and university-enterprise technology transfer

When the first stage of the project concludes, national centres for the dissemination of information through CD-ROM and access to primary documents will have been installed in each Andean country, mainly for the use of the scientific community, but with valuable information for business concerns. Efforts will be made to establish, at a second stage, information centres to benefit small and medium enterprises, according to their needs and characteristics. For this purpose, two kinds of service will be set up:

a) specialized information services by industrial sector or branch, based on the specific demands of local industrial networks; and

b) information services on demand to answer the queries of enterprises with reference to production techniques, patents, trademarks, regulations, etc.

The project will encourage the creation of these services in coordination with the trade sectors and industrial enterprises of each country.

Document 04

SERCOTEC: An Experience in Information Management

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Introduction

In today's highly competitive business world, information has acquired an importance and value which was unsuspected a few years back. In effect, business people, professionals, consultants, and business researchers are daily becoming more and more convinced that information is a decisive element in competitiveness and nowadays it is even considered a factor of production in the developed countries of Asia. To the traditional three factors of production, capital, entrepreneurship and labour, a fourth factor has been added: information.

Despite the fact that this seems very clear to professionals, researchers and business support organizations, it does not seem to have become generally known among the small and medium entrepreneurs of our Latin American countries. In effect, small entrepreneurs have not yet thoroughly understood the concept of information and consequently do not incorporate sufficient information of good quality in the decision-making process.

This is borne out by the fact that insufficient use is still made of the various services at the disposal of businesses in this matter, offered by private and state organizations. It is, therefore, necessary to attempt to define and set in motion strategies aimed towards finally bringing together information and the small and medium entrepreneur.

SERCOTEC and information

With reference to information in general and technological information in particular, SERCOTEC has been playing the part of collector, organizer, generator and distributor, in the conviction that, when entrepreneurs value and use information appropriately, it becomes part of the modernization process of the small enterprise.

In this respect, a series of instruments and programs has been launched, whose objective is to disseminate, vulgarize, and put at the disposal of the business sector, sufficient and up-to-date information in a timely and expeditious way. Amongst these

instruments and programs are:

Business Information System (SIE)

The Business Information System, which has been operating for three years, provides the following services:

- ***12 Databases***

These contain sufficient relevant information to service small businesses and include databases on suppliers of machinery and equipment; consultants and specialists in technology, quality, design, decontamination, marketing, etc.; investment ideas, profiles and projects; support organizations in the fields of technology, training, technical assistance, business opportunities; documents (books, specialized publications and journals); and so on.

- ***The CIPEMI Journal***

A specialized publication with information about technology, market, management, etc.

- ***A series of documents on labour and investment profiles***

Occasional publications on research, and sectoral analyses, with the purpose of facilitating the process of launching an enterprise (20 Labour Documents and 171 Investment Profiles).

- ***Expert services in various sectors***

The institution employs a number of specialists, to satisfy the demands of entrepreneurs with regard to assistance and specialized technological information, in the areas of: agro-industry, food, textiles, clothing, leather, footwear, metals, chemicals, plastics, wood, and furniture.

- ***An advisory service for entrepreneurs and potential investors***

This is given in a personalized and specialized manner. At the disposal of the entrepreneur in this area: bibliographical background, sectoral statistics, investment opportunities, modern technologies, investment ideas and projects, etc. This advisory service also offers a business advice telephone number.

- ***Technical library***

A collection of more than 5,000 volumes, publications, specialized journals, statistics and periodicals. In addition, the library participates in an exchange network with the public and private libraries of technology and research centres.

The Business Information System (SIE) operates within a network of national and foreign organizations that provide support for the small business: universities, research institutes, and technology centres. Noteworthy among them is the UNIDO Technology Information Centre, to whose network SERCOTEC-SIE has recently been linked, thus becoming the INTIB Focal Point for Chile. The Business Information System (SIE) currently services over 24,000 queries a year from small business concerns.

International network of small business support services

Composed of SEBRAE of Brazil, IMPI of Spain, NAFIN of Mexico, CORPOINDUSTRIA of Venezuela, DINAPYME of Uruguay and SERCOTEC of Chile.

The purpose of this network is to provide entrepreneurs of participating countries with contact possibilities with local enterprises, contact with commercial organizations and local sector support institutions, basic information about the country concerned, and technology information.

This network has been operating since March 1993.

Technology Transfer Centre

This Centre was set up as an alternative solution to a series of problems or mistaken concepts related to technological matters in small enterprises. Amongst these we must highlight: little or no access to information about appropriate technology, technological processes, materials and use of materials, market and financing, training in the use of new machinery and the application of new processes, and personnel skill development.

The Centre's relevant actions are therefore concerned with facilitating the small enterprise's access to information about appropriate technology, technological processes, materials and use of materials, the technology market, and available financing. They are also concerned with contributing to personnel training and skill development in the use of modern equipment, and with creating new industrial processes. All of the above takes place through seminars, meetings with entrepreneurs, publication of technology newsletters, and in-plant assistance.

Technology research

This consists of research into technology obsolescence in the various areas of the nation's economy and of specific technological subjects related to quality, decontamination, energy rationalization and so on. These studies are factual diagnoses of technology obsolescence; innovative processes are then proposed based on these investigations, working closely with the entrepreneurs concerned.

Encounters between suppliers and entrepreneurs

The idea is to make possible a means of contact between technology supply and

demand. The purpose of these meetings is to make entrepreneurs aware of current technology, its characteristics and terms of acquisition and financing.

Technology events

These events consist of analysis and decision meetings, including technology area specialists and entrepreneurs, on the subject of urgent technology issues and problems, and the incorporation of new technology and industrial processes.

Technology consultancy

This SERCOTEC activity is effected by compiling and maintaining a list of consultants and specialists in technology subjects and by contributing to the development of a consultancy market. Basically, this has been carried out by setting in motion subsidized in-plant technical assistance programs through the services of private consultants.

Problems and solutions

The main problems which have come up in the task of developing and communicating information are related to the motivation of small enterprises in the use of information. The culture of information does not yet exist among small entrepreneurs. It is not at present valued by them as a factor of production and competitiveness. Another problem which has been detected is that information does not flow smoothly between the generating centres and the distributors.

We can also add that there does not exist, at this level, a clear awareness of the fact that the information generated should reach the people who require it in good time. It is necessary, therefore, to establish, in the personnel involved, a sense of responsibility regarding this aspect. If it is our intention to promote awareness among entrepreneurs of the importance of handling information correctly, we must be ready with prompt and appropriate responses to their requirements.

Another relevant problem which must be mentioned here is the difficulty many small entrepreneurs encounter in reaching the information centres. This is due to the lack of time at their disposal for the steps required as well as to the distances at which they find themselves from the service points and, principally, to the lack of information culture which still prevails among small entrepreneurs and which significantly affects the efficacy of information systems and networks.

We must also mention, among the serious problems needing solution, the high cost of information. As costs get higher and higher, it is often practically impossible to maintain a system with sufficiently up-to-date information.

The problem of high costs becomes even more acute because it does not yet seem appropriate to charge small enterprises for information services provided. We believe that

the current European practice of charging for information services does not apply to our Latin American situation. There are conditions in Europe which do not yet prevail in our countries and to which we have already referred: the lack of awareness among our small entrepreneurs of the value of information as a factor of competitiveness and as a condition in the modernization process of their enterprises.

Another of the problems arising in this field is the lack of specialized information management professionals. This is extremely important, since a significant part of information systems is constituted by people who interview the entrepreneurs and prepare the answers to their queries.

The problems which have come up in the development of information systems suggest some solutions which we feel it is necessary to initiate.

- To publicize information as a factor of competitiveness at various opportunities such as conferences, seminars, and training courses. The idea would be to make entrepreneurs aware of the fact that, if they use relevant information, they will have access to the markets and be able to compete under better conditions.

- To include entrepreneurs more and more often in discussions on the subject of information, its importance as a factor of production and condition of competitiveness and modernization, information opportunity, relevant and available information, evaluation of information systems, and types of information they consider relevant and necessary. Thus, it is hoped to make entrepreneurs aware of the importance of relying on information in order to take correct decisions.

- To establish and operate a communication and information exchange network, both national and international.

- To install enough serving points. Regarding this, SERCOTEC is setting up a program, together with the municipalities, consisting of opening and operating communally an information office containing all the documents and databases of our Business Information System (SEI). In this way, SERCOTEC intends to bring information closer to enterprises, and so to make access easier. Along these lines, it is also hoped to reach an agreement with business associations to establish permanent communication with the SEI via computers. Notwithstanding the above proposals, it is thought advisable to initiate additional measures, for which we consider the participation of organizations such as IDRC important and necessary:

    - to establish efficient coordination through IDRC among information centres in Latin America, to permit a smooth and effective flow of information;

    - to obtain commitments to provide suitable feedback among the information centres incorporated in a network coordinated by IDRC, in

order to satisfy adequately the enterprises' demands;

- to establish mechanisms to allow permanent training of personnel in the operation of information systems, through fellowships, in order to learn and exchange experience in information management, organization of courses and seminars on the subject matter, and the distribution of technical literature;

- to organize meetings of enterprise managers, small enterprise support organizations which are operating information systems, and specialists in the subject of information;

- to produce a newsletter aimed at the small enterprise, on the subject of information, the objective of which would be to stimulate discussion among entrepreneurs about the advisability of using information and to disseminate and promote the use of existing networks and information systems;

- to standardize acquisition costs and information sale rates; and

- to finance information projects: technology databases, tariff regulations, technology, and consultancy for decontamination.

Document 05

Information Technology Policy Restraints in the Caribbean

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Introduction

If we accept a popular definition of information technology as electronic-based technologies used to collect, store, process, package and communicate information and provide access to knowledge, then we will immediately see that the concept embodies most of our everyday activities, be they business or pleasure. We have positioned ourselves in two market segments, namely Telecommunications and Industrial Plant Information acquisition and dissemination.

Telecommunications, as we know it, provides us with the transport mechanism to effectively collect and disseminate information and is, perhaps, one of the most popular transport media. The Caribbean has a well-developed telecommunications infrastructure that can support a wide range of informatics-compatible technologies. However, the inability to identify appropriate and homogeneous public offerings has prevented the widespread use of such technologies, and consequently the cost to the end-user has remained prohibitive. Over the last few years, we have helped regional and international groups, such as the Caricom Secretariat, CTU, CANTO, ECLAC, and the WMO, with formalizing their own strategies or acting as liaison between themselves and the telecommunications operators in the region.

With respect to industry, the emphasis has shifted from plant control to plant management by utilizing process control technologies integrated into existing corporate computing capacity, to provide information and knowledge processing. Consequently, we, as technocrats, face the challenge of moving the plant control data from the operators' control into the board room. This live plant performance data, when infused with world market and economic trends, provides on-the-spot information to enhance the decision-making capability of the organization.

Unfortunately, the opportunities are limited to the few industrialized islands within the region; we ourselves are deeply involved in this integration process on the Point Lisas Industrial Estate in Trinidad.

The issues

Unfortunately, the development seen in the region is not guided by policy but is technology driven. Policy implementation is carried out on a reactive rather than on a

strategic or tactical level. Politicians charged with the development of these policies are generally out of their league on the many issues under their portfolio and have not seen fit to employ regional consultants to help. Often, multinationals, such as Cable & Wireless, influence protectionist or noncompetitive policies in their favour, through our governments. Over the years, in the Eastern Caribbean, we have seen an infusion of value-added technologies in telecommunications. All these have been carried out as additions to the Cable & Wireless franchise and no amount of lobbying seems to make any difference to the governments concerned. Such policies continue to provide monopoly markets for multinationals that in the long term stifle the entrepreneurial initiative of the region.

One key area for development, on a regional basis, is the cable television market that provides a cost-effective medium, even more so than the raw telecommunications infrastructure, for information retrieval and dissemination services. The local networks could be interconnected through the region's digital telecommunications network infrastructure; and in the Caribbean our infrastructure is the finest.

Cable television in the region has so far not developed to any great extent. Islands in which Cable & Wireless does not provide the service are fraught with problems as the governments attempt to satisfy requests of this organization and those of private enterprises seeking a franchise. Cable & Wireless continues to insist that it retains its right to provide this service. Some governments, in an attempt to escape the impasse, ban issuance of licences or limit geographic jurisdiction of the local carrier.

To use cable television as a platform for information technology development, the service must provide other forms of entertainment acceptable to the public at large to achieve critical mass in the customer base, ensuring an affordable tariff. The obvious complementary programs are soap operas and movies, and one may assume that, with the influx of satellite broadcasting, it would be easy to get such programming. This however, is not the case. The Caribbean Cable Television Association (CCTA) has been having its share of problems with the Motion Picture Association and other related organizations on issues of copyright and intellectual property rights, as it relates to the licencing of regional users of this information. The problems that they are experiencing are, in essence, what I hope that we would be attempting to correct in the meeting this week. To give an example, let us look at the Caribbean Basin Initiative (CBI). The Motion Picture Association of America (MPAA), the trade representative of the motion picture industry, successfully lobbied the US Government to include a provision against infringement of intellectual property rights in the CBI aid package, or promise of aid, as we have come to know it. Caribbean governments were more or less coerced into giving undertakings to use their best endeavours to prevent theft of intellectual property - US intellectual property. There was no corresponding or commensurate effort requested of, or given by, the MPAA to ensure that the intellectual property of its members be made commercially available to potential bona fide purchasers in the territories of the Caribbean basin. The net result is a stalemate for those who genuinely wish to obtain legal distribution rights in the territories.

We are painfully aware that the supply of technology outweighs demand and capacity of users to employ technologies. This problem is further exacerbated by the fact that, even if the region does develop the capability to use these technologies, our

politicians, with their hidden agenda and with "big brother" (USA) looking over us, may prevent us having access to much meaningful information.

The future

For the future, the existing infrastructure of television, be it cable or over-the-air transmission, must evolve into an interactive medium, where viewers can decide the programming best suited to them, rather than the passive medium of today. The television set must become essentially a computer terminal with a supporting network, similar to a computer Local Area Network (LAN) as we know it today. This will allow households to actively participate in college programs of choice, scan department store catalogues for best buys, and request movies of choice.

Governments must enact the necessary legislation to allow ease of transborder information flow and ensure that present and future trade agreements (GATT, NAFTA) address the issues of copyright and intellectual property rights of the owners to prevent piracy and abuse. Information providers and brokers, on the other hand, will need to address the issues of compatibility and ease of use of their offerings, if the public at large is to benefit. Very important is the issue of security and privacy. No amount of legislation will prevent unscrupulous hackers from reaching information of a private nature. It behoves us, as technocrats pushing for connectivity and open systems, to ensure that we address the issue of security of access so that corporate suppliers of information on this global network can be comfortable with their choice.

Organizations outside the region, such as IDRC, have to continue to play a major role in influencing policy and increasing the awareness of information technology within the region, since the few capable resident individuals often cannot get the ear of those who set the policies.

We are well aware that many research grants, provided by such organizations to our governments, often bear no fruit because of dissimilar agenda, and therefore an alternate approach is necessary. These donor organizations need to engage private sector participation to spearhead the research initiatives, with the region as the prime beneficiary instead of the governments.

Document 06

FUNREDES and Computer-Mediated Communication in Latin America and the Caribbean

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Goals and orientations

FUNREDES, former REDALC Office of Union Latina (January 1988-August 1993), is an NGO aiming at the promotion and encouragement of the use of computer-mediated communication (CMC) technologies in the Science and Technology sectors of developing countries and especially in Latin America and the Caribbean (LA & C).

The main orientations of FUNREDES are:

- respect of the sociocultural environments,
- consideration of the globalization of information exchange patterns,
- demystification of technologies and understanding of their sociological and human impacts,
- user participation during all phases of CMC development,
- the organization of participatory, open, and pluralistic structures,
- the incentive for regional integration and sustainable economic development,
- the adoption of a systemic and integral vision of the problems of development and the push for:
    - regional integration,
    - partnership with the telecommunications operators,
    - partnership with the industrial sector.

Communication (especially intercultural and interregional) and information (especially scientific and technological) will be, rather than technology, the key interests of FUNREDES.

FUNREDES achievements

Since 1988, the REDALC Office of Union Latina has been carrying out both theoretical and practical activities:

- The definition of and studies for the REDALC Project (with EEC funding and in cooperation with Unesco and ACAL). REDALC, the main project of FUNREDES, is focusing on a global and comprehensive solution to the LA & C research networks problems. Practically all the other endeavours of FUNREDES can be considered as by-products or activities of the REDALC project.

- The MULBRI project (the implementation of a PC-based high level freeware package to ease access to research networks).

- The moderation of several (regional, subregional or national) electronic conferences (REDALC, SALSA, HAITI-L, KISKEYA).

- The study of the research networks' potential impact on the French West Indies' SMEs.

- The articulation of a specific methodology for launching research networks in developing countries.

- The initiation of the Peruvian National Network (RCP), in cooperation with UNDP.

- The creation and operation of the Dominican National Network (REDID), with UNDP and Unesco support.

- The creation of the Haitian National Network (REHRED).

- The organization of various training workshops for networks users (in cooperation with Unesco).

- The participation in a study for recommended telecommunication tariff policies for developing countries (ITU and Unesco).

All these achievements, the publication of several papers (in the Internet Society Newspaper and other Journals), and the participation in or organization of several conferences, make FUNREDES an active partner of the developing countries, involved in the impact of information technologies, with a particular awareness of Internet.

Although FUNREDES is primarily dedicated to the academic and research worlds, its orientations, together with the recent evolution of the Internet, make the organization very sensitive to the development of the SMEs in the emerging information-conscious world. As

a matter of fact, FUNREDES is currently preparing a project to be submitted to the Bolivar Program (Enlace Program), where some of the objectives would be achieved via partnership between public and private organizations (mainly SMEs).

Information technology policy problems

The field experiences of FUNREDES have allowed the collection of data and conclusions, as well as an acute perception of the acceleration of the process of transformation of the world towards a global information-driven market.

From our perspective, the problems which are being faced by IT policies are less and less technical, and not exclusively financial. The key obstacles for the dissemination of the ITs in developing countries are found in:

- the lack of training of IT professionals (librarians),
- the lack of preparation of executives (University, SMEs...) in the face of the drastic changes which are driven by ITs, and
- the difficult learning curve to transform people into skilled Internet users (aggravated by the weakness of interfaces and support mechanisms in current networks).

As far as the budgets are concerned, the telecommunication costs are the principal factor. Solutions exist at the regional level but suffer from the difficulties of the regional integration mechanisms. Another recommended approach is the elaboration of partnership mechanisms with telecommunications operators.

Recently, regional programs have appeared with a clear information orientation. Furthermore, since the publicly-stated position of the new President of the USA (during the campaign) on the importance of "the information superhighways", the theme has been widely covered by the media and is becoming fashionable.

However,

- the new regional programs do not always take into account the key ingredients for success in the newly evolving world (for example, incremental design, virtual enterprise concepts, and reduced bureaucracy); and
- the fashion phenomenon has the positive effect of accelerating market positioning and hence the prospect for inclusion in big budgets; the negative side effect is the risk of complicating the task where difficulties are greater (learning curve and social impacts), by reducing the dimension of the problem to the technology itself.

There is a triangle of forces which have to come together in order to provide a

smooth and efficient transformation towards the new information era: technological, market, and social. The introduction of IT has been, so far, a technology-driven phenomenon and the technological side is clearly in advance of the others. The time is coming when the market is going to lead the process. Social and cultural forces will be keys in the speed of the globalization process. New opportunities will appear for developing country actors: it is urgent to prepare them to participate in the definition of the future of their society. The risk exists that, if the market forces develop strongly without the required social and cultural counterweights, these promising opportunities for the development of the Third World may disappear.

Among the many challenges which have to be faced, one of the most important is the capability of the developing countries to participate in the market of information providers. Another is ensuring that their cultural characteristics are taken into account by the industrial world's information marketeers.

FUNREDES plans relevant to the theme of the meeting

FUNREDES's lines of action include some projects which will help towards a solution of the challenges thus revealed.

A subregional project.

CARITIN: This project explores the path towards regional integration with an information focus in the Caribbean. The objective is to boost progress towards integration within the Caribbean, thanks to the installation of a comprehensive information infrastructure. The project is in the definition phase. Budgets are required to pursue current national projects (Haiti network, in particular) and to conclude the feasibility study.

The creation of a comprehensive training framework.

USER-ORIENTED IT TRAINING PROGRAMS: Since the beginning of its activities, FUNREDES has acknowledged the utmost importance of the end-user and the simplification of his or her way towards a grasp of the technology. This has resulted in the current conclusion that there is need for a segmentation of training targets. Specifically-tailored programs have to be organized for different market segments:

- new end-users,
- email-only end-users,
- electronic library users,
- librarians,
- executives, and
- would-be information providers.

Document 07

Information Technology Research and Policy Enforcement in Small and Medium Enterprises

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At present I hold the post of Executive Sub-Director of the Chamber of Industry of Costa Rica, a non-profit organization whose objective is to assist in the country's industrial development. Although I fulfil several different duties, I am involved as much in small and medium industry (SME) support programs, as in information technology research and policy enforcement.

As regards SMEs, it is important to underline that Costa Rica is a country of small and medium entrepreneurs. In effect, 30% of industrial enterprises have 20 or fewer employees, and 90% no more than 50.

As regards research and information technology policy enforcement, I belong, as representative of the Chamber of Industry, to the National Informatics Policies Commission (COPOIN), a public entity participating in the private sector, attached to the Ministry of Science and Technology. This Commission's brief is to define, at a national level, directives and information technology policies which are binding for the public sector but guidelines for the private sector. At the same time it endeavours to promote rational exploitation of informatics, technical, and human resources currently available in the country's public sector. Some projects in development are the electronic booth, legal protection for software, and computing and informatics technical schools.

To conclude, I would like to add that the Chamber of Industry's short term plans for this subject are the following:

a) utilization of the United Nations Development Program (UNDP)'s TIPS (TECHNOLOGICAL INFORMATION PROMOTION SYSTEM) system network, in order to promote the exports, the technology exchange and the international business of Costa Rica's enterprises; and

b) establishment of a public database with economic indicators at a national and particularly an industrial level

Document 11

Small and Medium Enterprises in Ecuador

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As a result of the crisis with the agricultural export model of the 1960s, an "inward" development model was promoted during the following decade, based on structuralist proposals, which gave rise to an industrial environment capable of substituting imports. This industrialization occurred in a protectionist system, which contributed to generating significant industrial growth in a situation that was no longer market-driven, thereby encouraging the low-level competitiveness of industrial products.

At the end of the 1980s, as a result of another crisis and a new international order, the need to support a further restructuring process for national industry became clear, with a view to its adapting to the new reality and improving its levels of competitiveness.

General situation of industry.

Between 1965 and 1980, the manufacturing industry reported a growth rate of 5.5% per year, whereby its real production (in 1975 sucres) increased from 7.7 billion in 1965 to 29.5 billion in 1990, i.e., 3.8 times its initial value over the course of the last 25 years (CONADE-GTZ 1992; INSOTEC 1992a; this section is also based upon analysis by the author of National Accounts No. 14 of the Central Bank of Ecuador.)

This period had two major stages:

a) The first ran from 1965 to 1981, which we could call the growth phase, in which industry grew 8.7% p.a., increasing production 3.8 times (i.e., equivalent to the increase for the entire period, through 1990).

b) The second ran from 1982 to 1990, in which the manufacturing industry as a whole stagnated. Its growth rate was slightly positive at 0.13% p.a., and industrial production over the course of this decade thus languished at approximately 29 billion sucres.

Industry's share in the Gross Domestic Product remained practically unchanged over the period. It went from 15.2% in 1965 to 16.2% in 1990.

SME participation in the industrial structure.

In defining SMEs, this paper has adopted the criterion of number of employees per

establishment, wherein SMEs are those companies employing from 10 to 99 workers. Small enterprises were those with 10 to 49 workers, and medium enterprises those companies employing from 50 to 99 workers. Large enterprises were those with 100 workers or more.

The following summary is largely based upon analyses by INSOTEC and the author of the annual Surveys of Manufacturing and Mining from 1981-1989.

Number of establishments

In 1989, SMEs represented 83.4% of total manufacturing establishments. If we analyze the behaviour of the stratum for the 1981-89 period, we see a slight decrease in small enterprises, which go from 67.5% to 67.1%; medium enterprises grew from 15.9% to 16.3%; and large enterprises were stable at 16.6%.

Industrial Value Added

For 1989, SME participation in industrial value added (in 1975 sucres) represented 27.9%. The evolution of industrial value added, measured in terms of constant value added, (1975 sucres) went from 16.4 billion in 1981 to 10.7 billion in 1989, at a simple decrease rate of 33%. All strata show significant drops, with the largest for small enterprises, at a decrease rate of 44%, followed by large enterprises at almost 35%, and finally medium enterprises, which fell 26.6%, showing the best performance.

Employment

In 1989, SMEs represented 35.9% of employment generated by industry. The simple growth rate for all industry for the 1981-89 period was 6.6%. Nevertheless, SMEs made a modest contribution that was lower than the industry average, growing only 4.0% for the period, while large enterprises grew 8.2%. Medium enterprises behaved better than small enterprises, growing 4.9% compared to 3.3% for the latter.

Technology and Marketing

Few studies have been carried out with a view to studying the technological level of SMEs. Among them we can cite the study prepared by the Engineer Roberto Hidalgo F. titled "Desarrollo Tecnológico, Articulación Productiva: El Rol de la Pequeña Industria" [Technological Development, Productive Articulation: The Role of Small enterprises], in which, based on a study of small enterprises by Centro Nacional de Apoyo a la Pequeña Industria y Artesanía -CENAPIA- [National Centre for Support to Small Industry and Crafts], he states: "The CENAPIA survey reveals that the equipment and machinery employed by this stratum in 77% of cases correspond to imported machines, and of the latter, 67% were acquired used (this fact is confirmed by a study-census undertaken by the Chamber of Small enterprises of Pichincha -CAPEIPI- in 1992 among over 700 of its member companies.)"

The author goes on to say: "...if we understand technology in its broadest sense,

i.e., as everything related to process, product, machinery, equipment, design, some 58% of companies used national technology not owned by the company, 34% used own technology, and 22% used foreign technology.... As regards design, 44% of companies used national designs not owned by the company, 33% used designs owned by the company, and 23% used foreign designs." (Hidalgo Flor 1992)

Upon investigating the technological variable, the aforesaid CAPEIPI study found that 45.8% of the companies studied used manually-run machinery and conventional technology providing limited precision, 18.8% claimed they employed modern, commonly used, high-precision machinery, and 17.7% of companies indicated they used semi-automatic machinery (CAPEIPI 1992).

In terms of markets, the above-cited Hidalgo Flor study indicates: "43% of companies sell only to the local market, i.e., in the city and district in which they are located, 26% sell to the provincial market, 28% to the national market, and only 3% export."

Sectoral specialization

Upon analyzing the sectoral specialization of SMEs, based on sector participation in Value Added at Producer Prices for 1989, we find that the most representative sectors are sector 31 - Food Products, Beverages and Tobacco, which has a 32.2% share; sector 35 - Manufacturing of Chemical Substances and Chemical Products derived from Petroleum and Coal, as well as Rubber and Plastics, which has a 21.0% share; next we have sector 38 - Manufacturing of Metal Products, Machinery and Equipment, with 16.3%; and finally sector 32 - Textiles, Garments and Leather enterprises, with 13.5%. It should be noted that these four sectors represent 83% of SME Value Added for 1989.

Upon cross-referencing these data with the number of establishments and number of jobs, the result ratifies the relative importance of these four sectors, given that they represent 75.8% in the first case and 77.7% in the second.

Regional Distribution

Upon analyzing the data from the 1988 Manufacturing and Mining Survey (with data tabulated at the request of INSOTEC), we note that only five provinces - Pichincha with 42.2%, Guayas with 25.2%, Azuay with 13.0%, Tungurahua with 5.4% and Manabí with 3.9% - contain 89.5% of SME industrial establishments.

When we analyze regional distribution in terms of the variable of value added, we note that the aforesaid five provinces generate 90.9% of same, and that Pichincha and Guayas are basically the largest generators of value added, representing 80%. The same situation is found when we analyze the variables of employment, production and gross capital formation.

When we cross reference the regional distribution variable with sectoral specialization, we find that the four sectors (31, 32, 35 and 38) that, as we have seen,

dominate in terms of the country's SMEs, behave in different ways.

In sector 31 - Food products, for example, we find that five provinces - Pichincha, Guayas, Manabí, Cotopaxi and Azuay - include 84% of the establishments and generate 85% of the sector's value added, while Pichincha and Guayas alone contain 55% of the establishments and generate 76% of the value added.

SME requirements

The requirements of smaller-sized companies (INSOTEC 1990, 1992b; Durán et al 1993, and interviews with leaders of the Chambers of Small Industries of Pinchincha, Azuay, Guayas, Tungurahua and Manabí, May 1993, by INSOTEC technical personnel), generated by the situation described in the foregoing point, as well as by the adjustment and modernization process they currently face, are geared toward attainment of higher levels of competitiveness, and can be classified in two main groups:

a) the establishment of conditions that favour their sustained growth; and

b) the implementation of support services, making it possible to increase technological levels, business management training, labour training, strengthening their participation in markets and, particularly, fostering specialization and articulation with larger companies.

Among the appropriate conditions required for the environment we highlight the following:

- economic policy stability, clarity and consistency, so that there is confidence and certainty among economic agents and a framework of conditions for investment, production and consumption;

- introduction of changes that promote and ensure functionality and transparency of the legal and institutional structures, since without them the transformation of the macroeconomic environment is virtually inoperative;

- modernization of the economy, revision of the state apparatus, and evaluation of the levels of institutional functionality and efficiency;

- elimination of monopolies (both public and private); and

- labour legislation reforms to make labour markets flexible.

The support services required, in turn, can be classified in two major categories: financial services and non-financial services.

Among financial services we mention the following:

- directed, flexible and timely credit;

- unification of criteria and procedures used by the diverse development funds;

- channelling of resources geared to providing risk capital to companies, as well as for financing studies and projects;

- promotion of development of the guarantee system - today incipient - in favour of small enterprises;

- implementation of non-traditional financing mechanisms, to which small enterprises have usually not had access, such as leasing, discounting of documents, factoring, etc.; and

- special advisory services for financial administration of companies.

Among non-financial services we mention the following:

- technological support geared to improving the average productivity of companies, or the possibility of generating a technological development process per se;

- technical assistance geared to optimizing use of human, financial and material resources available in companies and, consequently, increase their productivity. For this purpose **in-company use of information technologies should be fostered;**

- implementation of measures making it possible to raise levels of business management, a determining factor for achieving substantial increases in company productivity and efficiency;

- with a view to fostering a better level of use of the installed capacity of SMEs, programs geared to improving the participation of such companies in public sector acquisitions should be implemented;

- organization and operation of subcontracting pools for integration of industrial processes, **using the information systems existing in the country as a management tool;**

- provision of support necessary at each operating stage of the export process; and

- establishment of an **flexible, modern and efficient information system,** permitting access to national, regional or world database centres that contain profiles and projects for investment, markets, supply and demand of technologies, machinery and equipment, human resources, etc.

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Document 12

Importance of Specialized Non-governmental IT Organizations in Developing Countries

Raulino Oliveira

Among the five important objectives of this meeting is to "assist IDRC to identify areas and events which must be considered in order to support their investigation of the Information Technology Policy Research Program".

The first stage of the discussions about these five objectives took the shape of an encounter in April of this year, during which certain study areas were identified as being the basis for determining the effectiveness of existing information policies, as well as the areas in which subsequent investigation could contribute to the formulation of effective information technology policies.

It is hoped that participants at this meeting will contribute their experience to identify:

- current and future requirements for the formulation of information technology policies,
- areas which need investigation in information technology policies in Latin America and the Caribbean, and
- existing opportunities for appropriate Canadian-Latin American cooperation.

Regarding the first point, about requirements, I wish to emphasize that in my opinion, the formulation of policies should emerge from the base up, and not as a government imposition.

As to the areas, it will be necessary to keep in mind that they will differ from one country to another or from one geographical area to another, depending on the various stages of development and their consequent special characteristics, as one can easily see in Latin America and the Caribbean.

In this short talk, I wish to refer most extensively to the third point: opportunities for cooperation.

My view of this subject is related to my experience, in the last thirty years in Brazil and particularly in the last ten years in Latin America, owing to my post as international Officer of the Latin American Integration Association (ALADI). The statements I will make are also based fundamentally on my experience as ex-President of the Society of Informatics and Telecommunications Users (SUCESU) - Brazil, and as Regional Director of

the Latin American Federation of Informatics and Telecommunications - FLAI.

In Brazil, policy on information technology, both at a federal and at a state level, was strongly influenced by the actions of several organizations related to the subject, which henceforth I shall refer to as specialized IT organizations. In 1965 the Society of Informatics and Telecommunications - SUCESU, was founded, initially in Río de Janeiro, then in San Pablo, and at present in almost 20 of the states of Brazil. Later other important entities emerged, such as the Association of Data Processing Services Enterprises - ASSESPRO, the Association of Data Processing Professionals - APPD, the Brazilian Association of Computing - ABC, the Brazilian Association of Data Processing Enterprises - ABEP, among others.

The most important point is that these specialized IT organizations hold meetings, seminars, regional, national, and international conferences, at which subjects are discussed according to the situation in the country or the region in which they are held. At all these events, subjects related to technological change and its impact on enterprises, specially SMEs, are analyzed; access to information technology, administration and organization of information technology, development of human resources and policies for information technology; all subjects expected by IDRC to be analyzed at the present meeting.

An extremely important characteristic is the considerable power to gather support that these entities have managed to acquire in different spheres: business, government, politics, and academia. A clear example of this is the fact that, from these meetings, emerged the basis for the informatics and telecommunications policies of Brazil. The formulation of Law 7232, better known as the Law of Informatics of Brazil, passed in 1984, was strongly influenced by the debates at each National Informatics Conference, dating from the 9th Conference which took place in 1976. Another fact to be highlighted is that the specialized organizations related to informatics and telecommunications have seats on the National Council of Informatics - CONIN, with equal number and voting power as the ministries represented on the council.

What message do I wish to leave at this meeting?

In the same way as among the states of Brazil, some more developed than others, we shall find, in Latin America and the Caribbean, pockets which are more or less conscious of the importance of having a political framework for the organization and development of activities conducive to more and better exploitation of information technologies.

This is why, rather than specialized cooperative actions for the development of policies for information technology in a specific subject in a given country, I propose a policy of Canadian - Latin American cooperation to organize associations or specialized organizations for informatics and telecommunications in Latin America and the Caribbean, guiding the tasks in such a way that, from their development in each country, the necessary policies be proposed, from the bottom up, respecting regional characteristics. The idea is that, instead of promoting the formulation of top-down governmental policies, the participation and interrelation of all the actors involved should be stimulated, so that, from their deliberations should emerge the policy for technology information suited to each

situation, thus ensuring involvement and active participation in all subsequent actions.

Finally I wish to draw your, and principally IDRC's, attention to the importance of the fact that an ambitious program in the subjects to which we are now devoted should anticipate horizontal cooperative activities, and must investigate the errors committed in the experiences of our countries. I have mentioned only a few of the benefits of the plan followed in Brazil and we will listen to other speakers referring to other situations. I make this comment at the end of my talk because I am as convinced of the vulnerability of the SMEs, as of the potential of their development.

Document 14

Information Technology Management in SMEs in Paraguay and Uruguay

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Following are some findings relative to information management derived from surveys of more than 110 SMEs in Paraguay and more than 140 in Uruguay, within the framework of cooperation projects for industrial renewal, financed by the European Union and the respective national authorities (COMISEC, Uruguay; Ministry of Integration, Paraguay). The survey concentrated on the more dynamic companies in the industrial sectors (textiles, garments, wood, non-metallic minerals, agribusiness, etc.), selected according to impacts on Mercosur.

The aspects relative to information technology, although not the target of the survey, were one of the points on which data was collected, particularly concerning information management, sources, and use. The studies did not seek results that would be representative in a statistical sense ("representative sample"), but rather in a qualitative sense.

Purposes of the information systems

For the purposes of analyzing the principal problems involved in information technology management in SMEs, the following parameters were used regarding the purposes of the information systems (ISs), including six different (although interrelated) functions.

Providing competitive advantage

The primary mission of ISs consists of providing tools to strengthen the company's competitive position.

Examples: use of a telecommunications system to connect with customers, obtain information on foreign markets, etc.

Knowledge of the company and its environment

To generate information providing just-in-time knowledge of the company's situation and its environment ("tableau de bord"), so that tactical and strategic decision-making is not delayed or hindered by the absence of information.

Examples: system of indicators making it possible to monitor sales evolution; executive information systems; external information-gathering systems, such as market surveys, etc.

Support for decision-making

This aspect complements the foregoing point and adds the possibility of having not only information, but also tools for analysis and study, models, etc., so as to support non-structured decision-making.

Example: simulation model for evaluating the effects of changes in sales prices, production costs, etc., on the evolution and results of the company.

Administrative tool

Automation of administrative and similar functions, making it possible to undertake these tasks with increased productivity, quicker availability of information, better quality information, and possible generation of company indicators and reports.

Example: Accounting, billing, sales and general transaction processing systems.

Production tool

Use of information technology in the company's production area (goods and/or services).

Examples: production management, lay-out organization, production scheduling, design, telemarketing, etc.

Company historical records

Recording of the company's historical information, in principle in database form, thereby avoiding loss of information and rapid and appropriate access to all data necessary for ad-hoc queries, grouped queries, statistics, studies, etc.

Examples: sales database, sufficiently structured so as to make it possible to project trends, perform market studies, etc.

Using these six dimensions the survey yielded the following findings:

- ***Strategic advantages***

Exceptional use of ISs.

- ***Knowledge of the company and its environment***

There are practically no companies in which information management has been

systematized. Knowledge of the company and its environment is partially supported by computerized applications, and, in rare cases, non-computerized data are subject to systematic organization for gathering and recording.

- ***Decision-making support***

Only in exceptional cases was information recorded in an IS or were specific tools (such as statistics) used for decision-making. Perhaps the most common case is the use of spreadsheets for cost studies, in budgeting, along with some simulation elements.

- ***Administrative tool***

This is the prevailing use and it is often identified with ISs. The survey showed that more than 50% of SMEs use instruments of this type.

Use in accounting, payrolls, invoicing, client account management, and accounts payable/receivable are the most common forms, followed by cost studies and control.

In these applications, there is a prevalence of aspects involving "automated recording of transactions," and neglect of the possibilities for generating information and for gathering information geared to company databases.

- ***Production tool (for goods and services)***

IS use in production processes is exceptional and its most common application is in stock management (bordering on Administration).

The use of design applications (CAD) in textile and woodworking companies seems to be the chief point of entry for more advanced technologies.

It was found that certain companies, while aware of the possibility of using CAD applications for design, assumed that these were not accessible (in terms of price and technology) for the company, but they had not made any special effort to verify that assumption.

- ***Company records***

It is not rare to find companies that have historical records of information, often supported by database management software. It is, however, exceptional to find systematic applications for database generation along these lines.

Problem areas

Underestimation of information systems' potential

This is the primary difficulty for development of information systems in SMEs. On

the one hand, there are theoretical expectations that can be very ambitious, but, on the other hand, the proposals for implementation tend to be very limited, concentrating on aspects linked to automation of administrative processes.

This limitation cannot be attributed only to the shortcomings of entrepreneurs, but also to the situation of the market, which offers limited types of applications (software), and to the services provided by computer professionals.

Information management is based more on the personal knowledge of the entrepreneur than on the existence of a system capable of generating information

This is perhaps one of the most specific characteristics of SMEs. In these companies, the entrepreneur, in addition to his or her ownership function, performs management and often production functions. This situation generates a relationship and a direct knowledge of the company, not only in administrative and management areas, but also in production.

Flooded with valuable, specific information, the entrepreneur has trouble systematizing it, either due to a lack of training, or to the complexity of the information, or to the need to be ever-present in the company, which makes it difficult to break away from day-to-day activities. An "excess knowledge" of many aspects of the company thus often goes hand in hand with a "lack of knowledge" of other aspects, particularly those requiring data processing.

Undoubtedly the clearest example is found in the difficulty SMEs have in achieving true cost systems, despite the fact that price-setting decisions may be an everyday matter.

It is difficult for the entrepreneur to obtain advice on information systems and technology (as defined above), and there is a prevalence of computer advice geared primarily to operating aspects

The introduction of computer technologies tends to take place via automation of administrative procedures.

Without questioning this strategy, or the validity of starting out via this route (where more applications are available to SMEs at reasonable prices, are relatively easy to use, and provide immediate, tangible results), we should underscore its limitations.

The main limitation is that, in the absence of proper advice, the entrepreneur tends to limit the potential for automation to transaction processing, leaving aside management use (reports, indicators, etc.), and limits use to the relevant software. Another major limitation is that automation of one area is rarely accompanied by an overall analysis of the development of an information system for the company as a whole, implying lost possibilities for organizational restructuring that derive from analysis of the company.

Consequently, computerization tends to stop at the implementation of some

standard applications, while computer advice stops at operating aspects or the development of some made-to-order software.

Lack of knowledge of supply of user-friendly applications and lack of applications adapted to specific SME needs.

The supply of user-friendly, economical and easy to use applications, both off-the-shelf and individually programmed, concentrates on standard administrative functions. Entrepreneurs tend to be unaware of the market supply, as well as the more interesting applications used in other companies.

In reality, the supply of software and applications is not limited to a certain type of more well-known and tested applications. However, these additional applications are not often adopted because their use implies, not only an economic effort, but also a long-term commitment within the company, which may be set aside in order to deal with day-to-day management.

Policy elements

In the light of these factors, certain elements suggest themselves in connection with a policy for promotion of information technology use in SMEs, such as those studied in these surveys.

A promotion policy

Like all promotion policies, this requires a relatively significant effort to raise awareness within the company, and to link the advantages of IT to everyday activities.

Not an isolated policy

These actions constitute another aspect of management training for SME entrepreneurs and should be coordinated with other actions and other policies.

Need for collective action

Given the significant number of SMEs, it is important to design efficient and effective tools that make it possible to reach a maximum number of companies.

Some promotional experiments, carried out in the framework of industrial renewal, indicate a need to deal with the isolation suffered by many SMEs, both from other SMEs and in their relationships with the government, and their difficulties in establishing relationships abroad.

The actions should be supported, on the one hand, by the carrying out of successful demonstrations at the level of selected companies, and, on the other, by the

establishment of forms of association of companies and promotion agencies, through which these experiences can be made known and disseminated.

Creation and diffusion of specific SME applications

In the field of standard administrative applications, it seems that the current market situation has provided for fairly broad diffusion of such applications. Nevertheless, in order to move on to a stage involving diffusion of the more advanced technologies, two requirements must be met: they must be user-friendly and they must be geared to SME needs.

In this regard, it is interesting to recall how PC-PC communication technology via modem has had difficulties in its implementation as compared to the diffusion of the fax. The latter product, although it has limitations compared to computer communications, still provides ease of use, which explains its success

Real demand and potential demand

Insofar as SMEs are unaware of many of the uses of information technology, IT diffusion cannot be based on explicit demand. Instead an effort must be made for diffusion and demonstration so that potential demand can be transformed into real demand.

It would appear to be necessary to create mechanisms to provide for better matching of supply and demand, allowing entrepreneurs to have better knowledge of the possibilities of information systems, and suppliers of information products and services to have a better idea of the needs of companies outside the everyday market.

Finally, it should be noted that many SMEs, particularly those involved in foreign trade, have information needs not only regarding market situations, but also in terms of contacts with potential partners abroad to sell their products, and it is not evident that technologies supported by databases and telecommunications can solve this vital aspect.

COMMISSIONED PAPERS

Document 08

Information Technology

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Introduction

Information technology (IT) has given rise to a new technological and economic paradigm which is radically transforming the production of goods and services as well as management techniques.[1] Various theoretical contributions (Pérez and Soete 1988) have pointed out that, in the early stages of the emergence of a new paradigm, the relative availability of knowledge and the lack of structure in markets and technologies open "windows of opportunity" for developing countries. To what degree, however, do these countries participate in the activities of the new paradigm?

Taken as a whole, the developing countries have little participation (about 12%)[2] in world production of electronic, informatics and telecommunications products. Only the countries in Southeast Asia have achieved a relatively successful penetration in the international market of PCs, peripherals and semiconductors (in the case of South Korea), even though largely based on contracts with computer manufacturers who assemble equipment from components produced in various countries.[3]

Even in the software field, in which capital requirements are fewer, participation of developing countries is almost insignificant, in spite of the efforts of countries like India.[4]

Some countries in Latin America and the Caribbean have also made considerable efforts to establish industries following the new paradigm, with varying results. Brazil applied, from the 1970s to 1992, a "market reserve" policy which protected local manufacture by multinational and national enterprises of large, medium and small informatics equipment, mainly aimed at the domestic market, the largest in the region. Mexico, on the other hand, has stimulated the PC industry with a plan which is open to direct foreign investment. Generally speaking, however, Latin America's position in the production of electronic equipment is modest (less than 2% of the world total).

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1 See Kodama (1990) for an attempt at quantifying the changes resulting from the new paradigm.

2 According to ONUDI estimates, 1989.

3 These countries had participated, in 1988, with close to 8% of the world's electronic production (ONUDI 1989, p.4)

4 India's software exports reached 260 million dollars in 1992. On how those exports were composed and Indian strategies in the matter, see Correa (1993).

The impact of ITs is not limited, however, to their use in the manufacture of informatics goods and services and others in the "electronic complex". They find application in the most diverse fields of economic activity, both in management and in the production of goods and services. The invasive nature of ITs is evident, therefore, both in the processes of production and enterprise organization and in the products themselves (from watches to automobiles), transformed since the incorporation of digital components. The industrial complex based on ITs has become one of the main disseminators of innovation in other sectors (OECD 1987), which have been provided with new processes or products, or have been given a complete "rejuvenation" (OECD 1988).

Consequently, the importance of ITs for developing countries, and for Latin America and the Caribbean in particular, must not be seen and measured only, or principally, in accordance with their possible effect on IT-based industrial production. They offer new opportunities to these countries inasmuch as their use becomes general in different industrial sectors, traditional or not. In particular, ITs can serve a wide range of small and medium enterprises operating in the region with a relatively low productivity, to face a more open and competitive economic field.

The main objectives of this investigation are:

a) to examine the factors which favour and inhibit the dissemination of IT and the access to relevant technology by small and medium enterprises (SMEs) in Latin America and the Caribbean;

b) to identify research subjects in the field of disseminating IT in the region's SMEs.

Given the diversity of components of IT and the important differences in the production and dissemination of products and services involved, the investigation concentrates basically on ITs linked to office management ("office automation"). Consequently, problems related to the dissemination of telecommunications and other information technology are only dealt with in a marginal manner.

The investigation consists of seven sections. In section 1, the conceptual frame of the technology dissemination process is examined, in the light of the available literature, particularly that which is aimed towards the analysis of the economy of technological change. Section 2 analyzes some of the main factors influencing the dissemination process of technology, analyzed within the framework of research on innovation. In section 3, specific aspects related to the dissemination of IT are dealt with. These are differences in the dissemination patterns by types of technology, sectors and enterprise size, and also the characteristics of IT dissemination in developing countries. Section 4) explores the subject of IT dissemination in Latin America and the Caribbean, on the basis of available information. This shows a picture of the existing degree of dissemination, of industrial policies and applied technologies and their recent changes, as well as of informatics policies. In section 5 the results of some empirical investigations on the adoption of IT in SMEs in industrialized countries and in two countries in Latin America are presented. Section 6 discusses some research subjects, from the perspective (currently dominant) of investigation of technological change, as well as from a more interdisciplinary

viewpoint. Lastly, section 7 contains the main conclusions of the report.

Dissemination of technology and the innovative process

The dissemination of technology has been studied from different viewpoints during the last forty years, based on budgets and hypotheses and within a framework of diverse disciplines. Some have focused on the adopters of innovation (Brown 1981); others on the market as a mechanism of interaction between disseminators and adopters (Metcalfe 1981). The subject has also been investigated from a spatial viewpoint (Hägerstrand 1952) and from a cross cultural viewpoint (Rogers and Shoemaker 1971). In spite of the importance of the theoretical and empirical work carried out, a "general theory" of technological dissemination has not yet been articulated (Gottardi 1986).

Without a doubt, the dissemination process has a special place in the economy of technological change. It is one of the most intensely studied subjects in that field, since the work of Mansfield in the 1960s (Mansfield 1961, 1968). However, the theory based on the well-known S-shaped curve does not provide a conceptual framework which is comprehensive and sufficiently articulated with a microeconomic theory on the determinants of technological change (Silverberg 1990, p. 177), despite the fact that recent studies on the economics of innovation have contributed to the clarification of various aspects of the role of dissemination in the innovative process.

In the first place, dissemination is seen as a facet of the process of innovation rather than as a subsequent and separate phase of that process (OECD 1992, p. 48). Technologies are improved and developed insofar as they are disseminated. Dissemination is, therefore, more than the simple adoption of an innovation in a static manner; it is a dynamic process which implies learning by the user and the producer and a sequence of incremental changes. The faster a technology is adopted, the faster the producer moves along the learning curve and the user accumulates experience in its use. Incremental innovation in the course of the dissemination process can be quantitatively more important than the original act of the invention, generating what has been called a "collective invention" (see Allen 1983).

Secondly, various investigations have proved the critical influence of the user-producer relationship in the process of development and adoption of technologies (von Hippel 1988). In the field of IT this is particularly applicable to the introduction of automated systems of production, which generally requires a close linking in the stages of installation, start-up, and ultimate system maintenance. Such a relationship is even more decisive when dealing with specific tailor-made applications (Snoeck et al 1993, p. 92).

Thirdly, the relationship between the dissemination of technology and the absorption capacity has been underlined in many investigations. In particular, it is noted nowadays that research and development in an enterprise actually play a double role. They do not only permit the development of new processes or products, but they also create the capacity to absorb technologies generated outside the enterprise. Frequently, a substantial absorption capacity is needed to understand and assimilate new knowledge, which generally implies in turn its own process of transformation and adaptation (Cohen

and Levinthal 1989).

Fourthly, the distinction has been highlighted, on the one hand, between adoption and dissemination of a technology, and on the other, between technology as "artifact" and as knowledge. The first distinction is analytically useful when considering the nature and timeliness of decisions regarding a category of potential users and the degree at which an industry's output is determined or affected by the adoption of a certain technology. The second distinction aims at the different subjects associated with the dissemination of a certain product or process and with the dissemination of knowledge of a certain technology. The greater part of the dissemination studies have concentrated on the first aspect and neglected the second, which provokes questions related to cognitive and assimilative capacity of different organizations.[5]

Fifth, recent studies show the existence of "growing rates of adoption" of a technology, that is, in many cases a technology is not adopted because it is efficient, but becomes efficient because it was adopted; the more is learnt about its use, the more it is improved and becomes attractive to later users. At the same time, the more users operate with a technology, the more advantageous its adoption becomes, and so externalities are generated and better prices and performance can be offered (OECD 1992, p. 41).[6]

The dissemination process, however, is not only determined by economic factors, but by organizational and social factors. In this respect the "social carriers of techniques" (SCOT) (Edquist and Edquist 1979) model is of interest. According to this model, a social carrier (for example, an enterprise) which chooses and instruments a technology, "takes" the technology to society. For a certain technique to be chosen and applied in a specific context, a set of conditions specified by the model and described below must be given (see section Experiences in Latin America and the Caribbean). An even more integrating theoretical perspective is that which inscribes the dissemination process in a wider context (see, for example, Howells 1991). Without ignoring the weight of profitability and other economic factors, this viewpoint introduces other variables to better understand the taking of decisions on the selection of technology, as a highly diffuse and heuristic process.

It has also been shown, with particular reference to IT, that societies tend to adopt these technologies not only on the basis of technical feasibility or economic profitability, but also to satisfy political objectives which vary according to the political-social development stages of the countries (Katz 1988).

In sum, technology dissemination has received considerable attention from the literature on the subject, particularly in the area of the economy of innovation. Diverse contributions have helped to clarify its relationship with the generation of technology and the factors which influence the rate and manner of dissemination of a certain technique.

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[5] See a survey on dissemination and innovation in Metcalfe (1988).

[6] "Network externalities" are evident in various fields of IT, such as in the use of certain operative systems, and in telecommunications.

In spite of the advances achieved, there are still gaps, both on the empirical plane and on the theoretical plane, especially as regards the link between the macro and micro analyses of the dissemination processes. The inclusion in the analysis of social and political factors make it even more difficult to understand a phenomenon which is already complicated as it is. But this inclusion seems essential, specially to understand differences in dissemination curves among countries, sectors and types of enterprises.

Factors which affect dissemination

The literature on the subject has identified a diversity of factors which facilitate, delay or frustrate technological dissemination. There is general coincidence, after Mansfield's seminal work, on the determining role played by expected profitability in the adoption of new technology, associated with the dimension of required investment, uncertainty, and reduction rate of the latter. Some of the main factors, examined in the context of innovation research, are addressed below.

Profitability

The profitability of a new technology can be derived from labour or capital[7] savings, greater efficiency in the use of energy, greater performance per input unit, better quality, or other advantages, whose relative importance varies according to the industrial branch, type of enterprise, etc. In any case, as observed above, profitability is a key factor in the dissemination rate of a technology. Frequently, however, as revealed in some empirical investigations described below, enterprises (especially SMEs) lack elements for an adequate reckoning of costs and benefits and initiate IT adoption processes without an appropriate evaluation of their possible impact on profitability.

Investment

In relation with investment required, the influence of economic cycles on the dissemination curve seems clear, with a rate which increases in times of expansion and decreases in times of stagnation or recession. However, economic contraction may coexist with a high rate of dissemination, when the new technology is perceived as useful to counteract (e.g. with increased productivity) the effects of the economic situation (Ray 1989, p.15).

Another influence on the dissemination rate, according to several empirical investigations, is whether the technologies can be incorporated piecemeal into an existing plant, even by way of trial and at a moderate cost, or whether they demand major changes. Divisibility or indivisibility of investment required to put in practice a new

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[7] The introduction of IT can increase productivity of work or capital, or both (OECD 1989, p 34).

technology is, therefore, an important factor to take into account (Ray 1989, p. 13).[8]

On the other hand, new technology is disseminated in a technological context, since its adoption can be restricted, owing to the necessary interrelation with old technologies.[9]

Characteristics of the products

The characteristics of the products obtained with the new technology are also a relevant factor. One reason for this is that process innovations usually cause changes in the products (e.g. improvement of quality). In some cases, the incorporation of new technology allows the manufacture of more complex and heterogeneous products, which does not necessarily attract potential users in developing countries (James 1991, pp.14–15).

The speed of dissemination depends on the relative competitive advantage generated by the new as compared to the old technology. The following five factors related to the product have been identified as those which affect dissemination:

a) The relative advantage or superiority in terms of, for example, better performance or safety and at a lower cost, generally judged by the price.

b) Compatibility with values, past experience and users' practices. Innovations which imply structural discontinuity will tend to be resisted more than those that don't; the same will happen with those that threaten professional or power posts within the organization.[10]

c) Complexity may delay dissemination, when it is perceived as an obstacle by potential users.

d) The possibility of a trial period, or the reversibility of an installation, facilitates adoption.

e) The visibility and communicability of an innovation have the same effect.

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[8] Within industrial automatization technology, for example, both types of technology exist: those which can be incorporated in a fragmentary manner (e.g. CAD, machines and tools for computerized numerical control) and those which require major changes at the plant level. There is also the possibility of modernizing and improving traditional equipment by what is known as "retrofitting".

[9] Frankel (1955) propounded the concept of "interrelatedness" of new and old technology, which as a matter of fact, is not only applied in relation to the link between old and new equipment but also to the changes required in the technical competence of production personnel.

[10] The authors quoted quite rightly illustrate this factor with the resistance encountered by the dissemination of PCs in centralized data processing departments, in contrast to its acceptance by managers in other areas.

Information

Limitations in the availability of technology information is another factor which may delay the speed of dissemination, particularly, but not exclusively in developing countries. An investigation carried out in Great Britain concluded that "awareness is still less widespread than it needs to be, with surprisingly many managers still believing that there is no conceivable scope for microelectronics in their particular business" (Policy Studies Institute 1982, p. 8.)

Context of dissemination

In addition to the factors mentioned, the speed of dissemination is determined in part by the characteristics of the national system for innovation, including the degree of competence through innovation, availability of qualified human resources and their motivations, the type and intensity of interaction between enterprises and research entities, among other aspects. Available infrastructure also plays an important part (James 1991, p.16).

In more general terms, it is expected that dissemination curves show more or less marked differences by sectors and among countries. Salary level diversity, size of domestic market, greater or lesser external openness (in terms of imports and exports), rates of demand growth, etc. can explain varying behaviour. In fact, the technological "gap" between industrialized and developing countries is not only seen in an abysmal difference in the capacity to generate technology[11], but also in the stock of technology in use, already disseminated. Several of the factors mentioned above, as will be seen further on, act as inhibitors of the dissemination of new technology in developing countries.

IT dissemination patterns

Differences in industrialized countries

The preceding sections provide a conceptual framework in order to examine the technological dissemination, as member of the innovation process, and the factors which affect it. Dissemination of ITs may be analyzed in such a context. They are a special case, but only due to the extraordinary invasiveness of these technologies, applicable on innumerable processes, products and services.

Numerous investigations (see Policy Studies Institute 1982; OECD 1989; Unctad 1985) have examined the dissemination patterns of various types of IT in industrialized countries. The evidence available indicates that the dissemination of ITs is markedly unequal by countries, sectors, enterprise size, and types of applications.

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[11] Developing countries account for only 6% of world expenditure on research and development (R&D). See Freeman and Hagedoorn (1992).

Thus, Japan and Germany show an intensity in the use of microelectronics which is higher than other countries in the OECD. Japan and Sweden are considerably ahead of other countries in the use of industrial robots. Japan is also ahead as regards the use of tool machines with computerized numeric control (OECD 1989, pp. 20–21).

The United States, on the other hand, leads in the dissemination of computers. Particularly, between 1984 and 1989, with the fall of prices and the increase of applications, the levels of computer usage increased significantly. In 1989, almost 51 million people 18 years old or older (28% of the adult population) used computers in the home, work or school (in 1984 the percentage was 18.3%) (Kominski 1989).

The IT dissemination rate is determined, among other factors, by the industrial structure. The use of IT is not even in different industrial sectors. The applications of microelectronics in products are more common in electrical and electronic, machinery and vehicle industries. In Germany and Japan, for example, 42% of electronic establishments declared these applications in 1983, compared with a general average for all industries of 13% (OECD 1989, p. 21). The applications of microelectronics in industrial processes are more widely disseminated in various sectors, but they are specially significant in the food, chemicals and printing industries (OECD 1989, p. 21).

Lastly, there are also differences depending on the size of the enterprises. Applications of microelectronics are more common in large establishments, although process applications are also disseminated among small enterprises. The enterprise's rate of production influences the capacity to redeem investment in robots (concentrated in large enterprises) and other equipment. Although automated tool machines allow more flexibility and efficiency in the production of small lots, the value-added of the production must be sufficiently large to compensate for the greater cost of equipment vis-a-vis the conventional kind. This circumstance has been neglected by the greater part of the literature, which considered flexible automation to be the source of an important loss in economy of scale (see Alcorta 1993).

Dissemination in developing countries

Literature referring to IT dissemination in developing countries - particularly in Latin America and the Caribbean - is less abundant and only clarifies partial aspects of the subject.[12] IT dissemination in developing countries presents various special characteristics which it is necessary to examine so as to define appropriate research and policy areas.

In the first place, the dissemination rate of informatics equipment is much lower than in industrialized countries. The same applies to flexible automation systems, probably as a combined result of several factors: less diversified industrial structures, smaller size of the companies, higher relative cost of equipment, and the lack of a direct user-supplier relationship, which is particularly important in certain types of industrial applications.

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[12] For an overview of such literature, see James (1991).

Secondly, ITs do not present an absolute advantage compared to old technologies, at least in the case of computerized capital goods. As shown in Mody and Wheeler's work (1990), the savings in labour costs and production time are not necessarily sufficient in certain activities to justify substitution of old technologies, taking into account, particularly, existing salary levels.[13] ITs (especially flexible automated systems) are more profitable when salaries are relatively high, although considerations of quality and execution of certain specific activities may also be determining factors in their adoption.

Thirdly, IT adoption is influenced by the characteristics of the final products, as already noted, which in developing countries may limit IT application, insofar as simple or undemanding quality products are manufactured. The same applies if production is homogeneous and this makes flexibility introduced by new technologies of small attraction (James 1991, pp. 14–15).

Fourthly, the enterprises' competitive background also seems to be an important determining factor in IT adoption. The need to produce according to international standards has been frequently identified as one of the main reasons for investment in capital-intensive technology. The current tendency towards liberalization and opening of the economies in developing countries may, in this sense, accelerate IT adoption, particularly to satisfy demands of quality (Ruffier 1986, p. 55).

Fifth, the possibility of efficient association of new and old technology is, equally, a factor which probably affects the dissemination of IT in developing countries. The incorporation of the first requires a certain infrastructure (for example, electrical supply), personnel availability, and adaptation capacity of organizational and production schemes. Technology is systemic, which makes it difficult to transplant if the environment is not suitable. Numerous examples of failed implantation plans exist in developing countries, due to lack of adequate consideration of this characteristic, mainly owing to deficiencies of management (Ruffier 1986). Incorporating computers generally requires organization and management changes, sometimes quite large ones, and a big investment in training. According to OECD,

> "It is estimated that increased skills and organization changes gave five times the improvements expected from technological changes alone. To achieve these objectives, a minimum of 1.5 per cent of payroll and 2 per cent of employee time is devoted to training. Training has shifted from being an expense to being an integral part of investment." (OECD 1992, p. 129) (in English in the original).

Sixth, in contrast to many industrialized countries, which have implemented industrial and technological policies deliberately aimed at promoting IT dissemination (OECD 1989), such does not seem to be the case in developing countries. Some incipient attempts, of a general nature, to stimulate technological dissemination exist, however, in Latin America, as discussed below.

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[13] The study revealed that IT application in the clothing industry in China was efficient as regards pre-assembly tasks, but at current salaries it was not, on the other hand, for the assembly and post-assembly stages (Mody and Wheeler 1990, p.64)

To be sure, the factors which influence IT dissemination are much more numerous and complex than the above points suggest. Credit availability, access to information, management attitudes and skills, rate policies, personnel training, unions' attitudes, are a few of them. In the next section, some of the factors mentioned, related to the situation in Latin America, are examined in greater depth.

Dissemination of IT in Latin America and the Caribbean[14]

Degree and mode of IT dissemination in Latin American industry

Information about the intensity and ways of using informatics in Latin America is fragmentary and comparable only partially among sectors and countries. Even though there are, at present, efforts to correct this situation.[15] methodological differences and the lack of a systematic census make an overall analysis difficult.

Brazil is the country with the highest number of installed computers - more than a million and a half - (Correa 1993), although Costa Rica has the largest per capita density, followed by Venezuela (10.8 and 5.9 per thousand inhabitants, respectively.)

The distribution of equipment shows structural heterogeneous qualities from a geographic point of view and from that of the size of the user enterprises. These are concentrated mainly (even, relatively, more than the total economic activity) in urban centres, while the main users are large national private and public enterprises, and, particularly, branch offices of foreign companies (CEPAL 1986).

Just as in the case of computing equipment, data on dissemination of flexible automation equipment in the region are poor and out-of-date. In Argentina, it was estimated (in 1986) that there were about 500 numeric control lathes, used mainly in the manufacture of oil industry equipment, agricultural machinery, pumps and valves (Chudnovsky 1986), and about twenty robots, concentrated in the automobile and electronic industries (Correa 1987). In Brazil, the number of computerized numeric control units was over 4,500 in 1989, there were about 2,500 CAD/CAM stations and 113 robots (Sobracom 1989; see also SEI 1988). More detailed information is available as regards capital goods in Colombia, where 25 enterprises (about 10% of the metallurgical enterprises) had numeric control tool machines, and fewer than ten had CAD systems. Only two installed CAM systems were identified. The great majority (84%) of the enterprises which have installed numeric control tool machines in Colombia are in the "large enterprise" category (Bernal 1988).[16]

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[14] This section is based mainly on Correa (1991).

[15] Such as those made in the Regional Programme Framework PNUD/ONUDI on Cooperation in Informatics and Microelectronics (RLA/92/014).

[16] Bernal (1988) presents the results of the PNUD Project COL/87/023.

Empirical evidence on the modalities of introduction of flexible automation in the region is not abundant either. Some studies (Chudnovsky 1986; Correa 1987) reveal that, in the case of numeric control tools and robots, their incorporation answers more to quality requirements, product consistency (in the case of foreign company subsidiaries) and improvement of working conditions, than to reduction of labour costs. Generally, firms which acquire these tools do not verify previous profitability analyses, there is little application engineering effort, and (in the case of imported equipment) serious maintenance and equipment use optimization problems arose. The lack of direct user-supplier relationship, for example in several robot installations in Argentina has caused enormous problems and operational cost overruns.

In the case of Colombia, it has been noted that a large group of enterprises introduced these technologies in order to compete more successfully with shorter production cycles and better order fulfilment; the "demonstration effect" has also been important, through the pressure maintained by enterprises introducing more advanced manufacturing systems (Bernal 1988). A survey carried out in Mexico revealed that the most important factor in the adoption of microelectronic-based equipment has been the need to achieve better and more regular quality, in the case of numeric control machines and machine centres. Reduction of costs ("scraps and tools") is the main reason in the case of robots (Domínguez-Villalobos 1988).

To sum up, and in spite of the precarious nature of the data available, there is no doubt that, compared to the dissemination which takes place in industrialized countries (Edquist and Jacobsson 1988; OECD 1989), Latin America lags considerably behind in the dissemination both of computers in the management of the industrial enterprise and in flexible automation equipment. It is also clear that the predominating disseminating patterns in the region show strong distortion, fundamentally owing to users' insufficient preparation to incorporate new systems and an inadequate relationship with suppliers of the equipment.

Industrial and technological policy

Industrial and technological policies can influence, in different directions, the dissemination of IT. Important changes have been taking place in the current decade in these policies, which, not so long ago, were mainly devoted to promote the substitution of imports within a protective scheme.

The new policies show a markedly different attitude.[17] In general they aim at achieving international models of productivity and quality, and lay a greater emphasis on the dissemination of technological and organizing innovations in the various sectors of the economy. This slant shows the perception that, in modern economy, technological development, organizing and management skills, qualification of human resources, and the creation, in sum, of comparatively dynamic advantages, are the central axes for an advantageous penetration into the international economy.

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[17] The report that follows is partially based on a study prepared by the author for UNIDO, in 1991

Illustrative of the new tendencies in industrial policy is the redefinition carried out on the subject in various countries in the region. It concerns the largest economies (Argentina, Brazil, Mexico), as well as the intermediate and small. As an example, the cases of Brazil and Mexico may be mentioned here.

In Brazil, the "New Industrial Policy" proposed a substantial change regarding the policies of the past. Competitiveness, rather that growth, becomes the strategic objective to be achieved, in line with the prevailing tendencies in countries recently industrialized and in the majority of industrialized countries. The "General directives for industrial and foreign trade policies" published by the Ministerio de Economía, Fazenda e Planejamento (Ministry of Finance and Planning) in Brazil on the 26 of June 1990, foresees the setting in motion of two "mechanisms" - "Industrial Competitiveness Program-ICP" and "Brazilian Program for quality and productivity"- and, among others, an "instrument" for "Industry technological training support".

The directives point towards a new path for industrial policies, characterized, on the one hand by its tendency towards the achievement of international models of productivity and quality and, on the other, by a greater emphasis on the dissemination of innovation and on management and labour training. The new policies suggest greater specialization in production and an enterprise model constituted by large enterprises, articulated with an extensive network of technologically dynamic small and medium enterprises, competing and associating with, in many and varied ways, foreign enterprises.

In agreement with the ICP, the stimulation of sectors such as microelectronics and informatics, biotechnology, new materials and fine chemicals will help raise the technological standards of a wide variety of user sectors. The Program establishes important institutional coordination cases, with the participation of representatives from ten sectoral groups.

In the case of Mexico, the National Program for Industrial and Foreign Trade Modernization 1990-1994, also suggests the replacement of the substitutional model of imports by one of "growth of national industry by means of the strengthening of an exporting sector with high levels of competitiveness".[18]

The strategy drawn up by the Mexican Program includes the internationalization of national industry, technological improvement and training of human resources. It "intends to accelerate the rhythm of innovation of products and dissemination of technological processes in the country's industries; develop their capacity to adapt to the changing demands of consumers; train and motivate the human resources required by development; and favour the utilization of environmentally sound industrial technology".[19]

In other countries of the region, structural adjustment policies have been applied, with strong implications on industrial and technological policies. Such policies are based

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[18] National Programme for Industrial and Foreign Trade Modernization, 1990-1994, Mexico D.F., 1990.

[19] same ref.

on market forces as a mechanism for the allocation of resources and, in some cases, look for new opportunities by trying to create or consolidate comparative advantages. Structural competitiveness seems to be the aim as a central objective. Growth per se, which dominated the scene of imports substitution, within a frame of reference of high protectionism, makes way for the search for higher levels of efficiency and an international market penetration based on genuine comparative advantages.

These policies are based on the implicit or explicit recognition of the emergence of a new technological and economic paradigm in which technological capacity, organization, and management skills, are essential conditions for success in a framework of an opening towards the exterior and competence. The central role of ITs and of marketing capacity is also acknowledged, mainly in order to have access to external markets.

Industrial and technological policy begins to emphasize the need to disseminate generic technology (such as informatics), which can increase productivity and open new economic opportunities. The stimulus of new technologies, particularly from the perspective of their use in production, is placed, in this way, in a context which tends to eliminate tension between producer and user and to maximize the exploitation of their potential.

Informatics policies

The establishment of institutions and policies in the field of informatics started in several countries of Latin America in the 70's. Cuba and Brazil are among the pioneers. Argentina, Mexico, Peru, Costa Rica, among others, adopted or reformulated their national informatics policies during the 80's.

The breadth and content of informatics policies have differed considerably among Latin American countries. For the most part, they have taken up specific aspects, specially those related to public sector contracts. Only in the case of two countries (Argentina and, above all, Brazil), were policies put into practice by virtue of which an effort was made to act more or less simultaneously in multiple areas (informatics industry, software development, human resources, R&D, etc).

The degree of implementation of these policies is, likewise, varied. In Brazil, a significant advance was made in industrial policy and the training of human resources. In Cuba, considerable progress has been achieved in some applications, such as medical and hospital informatics. In other countries, results of the policies set up were partial and have not yet been systematically evaluated.

Hardware production

Brazilian policy was noted, until 1992 for its clear orientation towards the internal market, based on the "market reserve" concept, that is, the exclusion of imports and, even, the local production by foreign enterprises of certain types of products covered by the reserve. Exports were not an important objective in the informatics policies of Brazil.

The market reserve policy allowed the control at the end of the 1980's of more than 50% of the informatics market by national enterprises. Foreign companies, although excluded from reserved areas, were able to participate in a rapidly expanding market, increasing their invoicing (in dollars), in spite of the tendency of hardware prices to decrease.

The industrial policy of Mexico in the informatics area has differed substantially from Brazil's. Although in its origins (1981) it shared the objectives of technological development and national integration, particularly since 1984, in the setting of a general liberalization of the economy, the focus was modified substantially. Mexican policy aimed at obtaining locally assembled equipment at prices comparable to those in the United States and to generating significant exports. In fact, exports of informatics equipment increased nearly eight times between 1985 and 1992. In this last year exports will have, for the first time, overtaken computing equipment imports (Whiting 1993, p.4).

In the case of Argentina, the policies designed by the National Informatics Commission proposed an intermediate path based fundamentally on the internal market (but without a Brazilian-style closing of frontiers) with exports foreseen in the medium-term. With policies conceived mainly to set in motion a "technological learning" process, the support program (decree 652/86) contemplated steps with the purpose of gradually increasing national value added and the technological component. Although some manufacturing plans were set in motion, they were revised or interrupted towards the end of the 1980's as a result of a change of macroeconomic policy and the great instability of the economy.

Dissemination policies

In Latin America and the Caribbean there are no - save for some exceptions - policies deliberately aimed at promoting dissemination of IT.

The DINFOPYME and AUTOMAT programs in Argentina aimed at improving knowledge of the technologies of informatics management and automation, respectively, in small and medium enterprises. In Venezuela, a training program was begun, to assist in the computerization of small and medium enterprises. The government, through FIM Productivity, established grants to finance the necessary consultancy studies.[20]

In some countries of the region the main dissemination policy was based on keeping import tariffs low, under the hypothesis that this scheme would naturally lead to an adequate rate of equipment and software introduction. In Chile, this dissemination took place with a certain intensity parallel to a significant development of local software production, which generated an interesting volume of exports, which in 1992 stood at 12 million dollars a year. In Costa Rica, the opening to equipment imports was complemented

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[20] Pilot experiences of this type were also anticipated within the Regional Programme for Cooperation in Informatics and Microelectronics (RLA/86/003).

with other dissemination policies in the educational area.[21]

A frequent criticism aimed at local hardware industry promotion policies has been their negative impact on technological dissemination, principally in consequence of the higher prices and low technological standard of local production vis-a-vis those obtainable through imports. Evans and Bastos Tigre (1989) have argued that, in spite of the higher prices deriving from the market reserve, the existence of a vast local production stimulated demand in Brazil, and promoted rather than delayed the dissemination of informatics in that country. The value of this hypothesis can be confirmed by the importance of the supplier-user relationship in the introduction of new information technology and, particularly, by the knowledge of local conditions and needs.

The supplier-user relationship is particularly decisive in the case of flexible automation. The existence of local production allows the establishment of a relationship which can determine the adoption or not of that technology. Local industry can, in spite of the higher prices, have "a positive effect on dissemination, because local firms seem more inclined than foreign ones to teach their local clients the technique, and to provide good repair and maintenance services" (Edquist and Jacobson 1988, p. 188).[22]

ITs in SMEs: empirical evidence

Experiences in industrialized countries

Observations indicate that company size has been identified in industrialized countries and in Latin America as one of the factors influencing the type and scope of IT diffusion. Some studies, although scant, shed light on the dynamics of incorporating ITs in SMEs and, to a lesser extent, on their impact on SME operation.

Schroeder et al. (1989) studied the relationship between the introduction of advanced manufacturing technologies and competitive capacity in twenty SMEs in Massachusetts involved in machining, plastic injection and instruments for metal cutting. The primary conclusions were as follows:

- The adoption of new techniques often does not improve (but instead worsens) financial performance and does not provide the expected benefits, due to lack of adequate cost control, management and personnel training.

- While such techniques improve precision, they do not necessarily lead to better quality. Often a large part of the improvements in quality are derived

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[21] The Programme, probably the most ambitious in the region, aimed at installing 4,200 microcomputers in 210 laboratories in public schools all over the country.

[22] These authors point out, in the case of South Korea, that the lack of engineering skills and the refusal of the Japanese suppliers to send their scarce applications engineers to South Korea, were at one period, the main obstacles for the incorporation of flexible automation technology in that country (pp. 185–186).

from other changes necessary to make the new technology operative.

- The incorporation of new technologies tended to worsen problems of cost and labour control, but substantially improved work productivity.

- First-time implementation of new techniques required unplanned changes, took more time than expected, and involved special efforts for employee acceptance and training.[23]

- The incorporation of ITs often responded to pressure from clients who stipulated the type of machines the companies should have in order to qualify as suppliers.

- That incorporation, at best, implied — in the perception of the managers interviewed — temporary advantages in terms of costs, quality and delivery times, which benefits were in reality transferred to clients as other competitors adopted similar technologies.

- Companies having proprietary products tended toward less use of advanced manufacturing systems, probably due to the fact that in such companies manufacturing represented a smaller portion of the value added vis-a-vis design, marketing and distribution.

Some authors have indicated, however, that SME limitations in the incorporation of ITs are eventually offset by certain advantages vis-a-vis the large firms. They are more selective and make an incremental investment, and "frequently managers can see more clearly what the benefits and problems of their automation decisions are and be more effective in their implementation" (Meredith 1987, p. 256). Mazzonis has studied the experience with the use of ITs in the small silk industry in Como (Italy), within the framework of an interesting government support program, and his findings may be relevant for developing countries. In particular, he points out the importance of retrofitting old machinery, which avoids investments and a bigger jump to a new system, and makes it possible to operate with a technologically more efficient mix of new and old technologies. The author observes that "this practice has not only aided the diffusion of innovations, but has also favoured the development of new systems in line with local needs" (Mazzonis 1988, p.81).

Experiences in Latin America and the Caribbean

Within the framework of projects implemented by the United Nations Organization for Industrial Development and the United Nations Development Program.[24] the degree

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[23] The impact of the introduction of IT on skills has been studied extensively. For the Latin American case, see Casalet (1986) and Neffa (1987).

[24] Projects executed within the framework of the UNDP/UNIDO Regional Program on Informatics and Microelectronics (RLA/92/014).

and modes of use of ITs in industrial SMEs in Argentina and in Ecuador were analyzed, with a view to defining actions geared to promoting the incorporation of ITs.

The aforesaid projects were founded on the premise that ITs can constitute a powerful tool for industrial modernization and, especially, for increasing the competitive capacities of small- and mid-scale industries. In small and medium enterprises, depending on their activity and strength, use of information technology in management can make considerable contributions at low cost. The introduction of microcomputers to operate control systems for automated processes (machine-tools with computerized numeric controls: MTCNC) can help in certain circumstances, depending on the scale, product, etc., to substantially improve productivity. Nevertheless, a series of obstacles must be overcome to accelerate[25] the adoption process. A fundamental point is that the expected increases in productivity will not take place if the organizational and learning parameters setting the conditions for making use of technology are not taken into account. It does not make sense to spend money on equipment if the organizational structure of the company is inadequate, if the system and equipment to be used are not appropriately defined, and if the management and operating personnel are not trained in their efficient use.

The following subsections describe the chief findings of the projects, which in both cases studied SMEs in the metalworking industry.

Argentina[26]

General findings

The fifty companies selected and surveyed in the Federal Capital and a sector of Greater Buenos Aires were relatively small; the majority employed less than 50 persons. The prevailing work process was geared to generating short series of homogeneous products, giving a great deal of importance to production based on customer orders, which are necessarily of a changing nature. Frequently a single company acted as subcontractor for other companies and at the same time also subcontracted to others.

The persons who were interviewed and responded to the survey were, for the most part, owners or managers of the SMEs. They often were clearly aware of the fact that the process of introduction of new information technologies could imply many benefits for their companies. Nevertheless, the companies did not have all the existing information regarding the potentials of information equipment and systems. This was even more evident when the services were subcontracted outside the company. In other words, the more intensive the use of information equipment within the company, the more information and awareness there was regarding its potentials in terms of production and

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[25] With the growing mass production of computers, sooner or later even small enterprises will end up adopting some form of computerization. If this is the case, the dissemination problem would affect the speed and the quality of the change, more than its direction.

[26] Text based on Burghi et al (1992).

management applications.

The study showed that the process of introduction of new computerized and organizational technologies has advanced in Argentina, although the country still lags behind more industrialized nations. Only four SMEs, i.e., 8% of the total, responded to the survey by indicating that they "did not use any of the innovations mentioned on the form."

As regards the means of production and equipment, most of the companies faced two types of problems: on the one hand, technological obsolescence or significant mechanical wear and, on the other hand, idle production capacity, due to recession or to the installation of surplus production equipment because of forecasting defects or unfulfilled expectations. This situation makes it possible to postulate that, in the event that a sustained process of economic growth is generated and/or consolidated, those deficiencies could come to stimulate the purchase of computerized means of production or the incorporation of ITs in conventional equipment.

The number and quality of computer professionals working as permanent staff in companies equipped with PCs and who had the required training was still very low. This was due in part to the high salaries prevailing in the market for computer professionals and in part to the habit of subcontracting them during the time of their actual use.

Once the problems to be solved both in production and administrative areas had been identified, the introduction of information technology in any form was not sufficient to permanently resolve them. Organizational changes had to be made first, or had to accompany the computerization or automation process, if the greatest benefits were to be reaped from implementation of the process.

Most of the companies surveyed produced for the internal market, but some exported with very good results. The latter are necessarily among the more effective, since they have to deal with severe international competition, which encourages them to incorporate ITs. Administrative problems for dealing with customs services, making banking transactions, hiring shipping, preparing and packaging of the product and ensuring compliance with international quality standards are, along with the difficulties in obtaining soft loans, the biggest obstacles to development of exporting capacity. But here ITs can do little to solve the problems, although they can constitute a solid support for incorporating management innovations.

Most of the companies had some time ago begun implementing programs for rationalization of production and administrative tasks, and foresaw an intensification and modernization of that process. It could not be established whether such programs had been drawn up prior to computerization with a view to taking better advantage of subsequent technological innovations.

Almost 60% of the SMEs surveyed had personal computers (PCs), and the percentage was higher if we add those that subcontracted computerized services outside the company. As regards intensity of use of computerized equipment, over 80% made moderate or intensive use of the same.

At the time of doing the survey, the SMEs that had introduced technological innovations had mostly begun that process by the computerization of administrative and office tasks. Plans for the next three years, however, gave preference to computerization of tasks directly involved in production, especially machines tools with numeric control and, to a lesser extent, CAD/CAM systems.

The most serious and urgent problems identified in general among the firms surveyed and which they foresaw tackling with computer assistance were as follows:

* production planning and control;
* control of stock and inventories of inputs, spare parts and finished products;
* scheduling of preventive maintenance for equipment;
* automated quality control; and
* compliance with international quality standards, particularly in the case of companies planning to export.

The managers of the SMEs interviewed had the conviction that the computerized equipment necessary for their companies was available in the market or could be imported rapidly and at low cost, whereas in regard to permanent hiring of competent, experienced professionals, they felt that the problem was the fact that, while there are many such professionals around, they are relatively expensive.

Application of the SCOT model

The Social Carriers of Techniques (SCOT) model is based on various conditions that must be met for the incorporation of a new technology. They include the **interest** of a company in doing so. The company must also have the appropriate **organization** (which generally must be modified to receive ITs), along with the **ability** to incorporate the new technology (e.g., situation vis-a-vis trade unions), and have the relevant **information.** Moreover, the entity in question must have **access** to the technology (which depends on the availability of capital, public policy restrictions, etc.) and have or acquire the **knowledge** to operate and maintain the systems and equipment incorporated.

Upon application to a sample of 41 SMEs in the metalworking sector[27], the results of the survey indicated the following (van der Poel 1992):

* A marked interest in IT, particularly machine tools with computerized numeric control (MTCNC) and CAD. A major reason for their introduction is linked to the improvement of competitiveness both in the local market and

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[27] 78% of the companies used one or more PCs; only 5 used MHCNCs (22% planned to introduce them), and 7% CAD (15% with plans to introduce it). The study mentioned in the text was performed in coordination with that mentioned in the foregoing point, within the framework of the above-mentioned UNDP/UNIDO Regional Program.

for accessing export markets, by means of cost reduction and quality improvement (as well as design improvement, in the case of CAD).

* The importance in small companies of the owner/director/manager, whose attitude toward introduction of new technologies is decisive.

* The companies that incorporated MTCNC did not show organizational problems.

* They likewise did not have problems in terms of being able to adopt information technologies.

* The availability of information was identified as a major problem.

* Access to technologies was not perceived as problematic, while the absence of financing may limit it. Over half the companies surveyed planned to finance the incorporation of IT with own resources.

* Knowledge for operation and maintenance of equipment/systems raises more complex problems than with traditional technology.

Ecuador[28]

The project included case studies of eleven companies of different sizes (the largest with three hundred employees).

The computer development attained in large industries[29] of the metalworking sector in Ecuador has been the result, in most cases, of isolated efforts, at excessively high costs. There has not been cooperation from training institutions or from government agencies who might have provided advisory services during the development of computerization in these companies. The advice they have obtained has come and continues to come primarily from foreign companies and universities.

The computerization process undergone in some of these companies did not start with prior preparation of a computerization plan, and, as a result, the structure is not very clear and there is often an under-utilization of the equipment acquired, much of which does not fulfil the companies' requirements.

The non-existence of a computerization plan prior to implementation of the system has also implied that these companies have incurred unproductive expenses, at high costs, in the acquisition of software and hardware.

Although informally, these companies have integrated the different areas of

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[28] This section is based on the findings of Carrillo (1991).

[29] "Large" companies are considered those in the range of 160-300 employees.

management, production, and manufacturing, they do not have an integrated information system allowing them to have better control and knowledge of the functioning of their companies.

They show low development in the area of automation of industrial equipment. Micro-enterprises, unlike the large ones, show very limited computer development. At the most they have two personal computers, with a little software providing general applications for administration of the company. They have not automated the industrial equipment used in manufacturing processes. Their annual production activity does not justify their making an investment to computerize and automate the company, since they would not manage to cover the respective costs.

According to the study in question, one of the chief difficulties for introduction of ITs in industry is the lack of knowledge and the small size of the market for introduction of product or process innovations based on ITs.

Research subjects

As stated above, the theory regarding technology diffusion is still not an organic body of knowledge. Nevertheless, considerable progress has been made in understanding the phenomenon, particularly from the perspective of innovation theory. The lacunae found in the theoretical field are reflected in the empirical field as well. For example, there are several studies on the determinants for adopting an innovation, but few examine the impact of innovation on the profitability and competitiveness of the companies. There are also not many that explore the effects of diffusion on the market structure (Silverberg 1990, p. 178).

To what extent are the findings of the studies on industrial innovation undertaken in industrialized countries relevant to and applicable in developing countries? C. Cooper has examined this question, and has given it a positive answer, although recognizing the need to place special emphasis on the learning and imitation processes (Cooper 1993, p.33). At the same time, Cooper notes the scant empirical evidence available on innovative behaviour in companies in developing countries (idem, p. 32). That lack is particularly acute in the case of micro studies on innovation in small and medium companies (Bhalla 1991, p. 7).

The problems of IT diffusion in SMEs in Latin America and the Caribbean include, on the one hand, the inadequacy of the studies on diffusion/innovation, plus three additional difficulties: first, the limited knowledge of the processes of learning and adoption of technologies in SMEs in the region; second, the lack of reliable and comparable statistics on IT diffusion and on the processes of incorporation at company level; and, finally, the great disparity in infrastructure, availability of personnel, accumulation of knowledge, public policies and other relevant factors in different countries of the region,

which limits any attempt at generalization.[30]

The studies reviewed in the foregoing section, point b), provide evidence of several of the limitations indicated. On the one hand, the findings regarding the samples studied cannot be generalized for the entire metalworking sector, or transferred to other industrial sectors. On the other hand, those studies contribute to our knowledge of the degree of diffusion and the reasons for adoption of ITs, but tell us little regarding their impact on productivity and competitiveness of the companies, or other aspects of their performance. They do, however, clearly indicate the differences in adoption of ITs according to the level of development of the countries, the importance of access to knowledge, and the absence of public policies for credit and technical assistance to facilitate and guide such adoption.

A better understanding of the motivations, characteristics and implications of the adoption of ITs by SMEs in Latin America and the Caribbean requires a comprehensive research program in at least three major areas.

SME adoption of ITs

It is necessary to understand more about the process of production and innovation in SMEs in diverse industrial sectors in the region and the role — both actual and potential — played by ITs in that process. As indicated above, it is highly probable that situations will be very disparate regarding use of ITs, and will be determined both by the type of technologies in use and by the effect of multiple factors that influence the rate of adoption.

Some possible hypotheses regarding factors that may influence the rate of adoption of ITs by industrial SMEs in the region include the following.

In the first place, given the incidence of the macroeconomic framework in which the company operates on the choice for new technologies (OECD 1989, p.43), it is possible to assume that the low rates of growth and investment, scant expectations for profitability of industry, limited (or non-existent) availability of credit, among other factors, have contributed decisively to delaying the diffusion of computerization in the region during the 1980s.[31] While the economic situation has begun to improve, the SMEs are in many of the region's countries among the companies most affected by the process of liberalization and structural adjustment. The latter, however, will probably force the companies to improve their processes and products and, eventually, to incorporate ITs, provided that the company as such is economically viable.

Second, in the context described, there has also been a sharp drop in real wages, while the cost of capital has been high and credit scant. Under these conditions, it can be

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[30] Bhalla notes, in this sense, that while SMEs present a certain homogeneity in industrialized countries, in the developing countries there is a coexistence of small artisan-type companies in the informal economy, with SMEs in formal sectors, with very different types of organization and technological capacities (Bhalla 1991, p.1).

[31] The accumulated change in the GDP growth rate in the region was only 11.7% between 1981 and 1989.

assumed that the typical incentive for computerization/automation existing in industrialized countries, with substitution of capital for labour, has not worked here.

Third, in many of the region's countries, the drop in the cost of equipment (excluding PC-type equipment) has been less rapid than in industrialized countries, as a result of customs surcharges, high profit margins for importers, or higher installation costs. The costs for installation and maintenance and, if applicable, the reorganization of the company to use the new resources, can significantly surpass the mere costs of "acquisition" of the respective hardware and software.

Fourth, factors such as the lack of knowledge of the technology, inadequate organization, lack of management capacities, lack of qualified personnel, and poor labour relations in the company (made more tense by wage conflicts) have probably also played a major inhibiting role. Frequently added to this are the bad computerization experiences of some companies, due to defects in system conception (especially excess capacity vis-a-vis the real needs of users) or deficiencies and costs of after-sale services and maintenance.

Fifth, as specifically regards automated production equipment, the price of the equipment[32] in relation to the cost of labour explains to a large extent the low rate of adoption of equipment. The possibility of producing small lots does not necessarily mean that flexible automation is, in economic terms, accessible to small and medium production units, since the cost may only be amortized if the aggregate production volume is of a certain size. It can be assumed that the prevailing considerations for adoption of flexible automation equipment in Latin America have, until now, been more linked to aspects of quality and technology than to relative prices of labour and equipment.

The most probable installations are those not implying radical changes in the plant, but instead partial adjustments combining old and new technologies, including retrofitting of equipment in use. In general, larger companies are better positioned to take advantage of ITs than small companies.

Research in this area should take into account that the technological capacities of SMEs are in general confined to production capacity, rather than innovation in new processes and products.[33] Studies should proceed on the basis of surveys of selected sectors, and apply interpretative models that integrate economic, organizational and social factors, like the SCOT model. That integration appears to be essential for understanding the phenomenon of diffusion in diverse sectors and the adoption mechanisms at company level. The aforementioned studies could be complemented by case studies, including companies that have incorporated ITs and other, similar ones, that have not done so.

Impact on competitive capacity

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[32] There are no recent comparative studies, but in the framework of the tariff protection policies prevalent in Latin American, the internal prices of equipment in the 1980s have generally been more than 1.5 times higher than the international prices. This relationship also holds for equipment not produced locally (such as robots) (Correa 1987).

[33] Application of the Dahlman and Wesphal's (1985) classification of "technological capacities" may be pertinent here.

The impact on competitiveness of adoption of different types of ITs is one of the least-explored subjects in the literature. Such studies would make it possible to measure the advantages that companies eventually obtain with such adoption, including in terms of productivity, profitability and competitive capacity. Moreover, these studies should examine the effect of introduction of different types of ITs in management and production activities and, additionally, undertake a comparative examination of that effect in different (selected) sectors.

The methodology to be employed must cope with several difficulties. In the first place, it must isolate the impact of ITs from that of other micro- and macroeconomic factors that influence company performance. The macroeconomic conditions, marketing capacity, access to distribution channels, and management professionalism are among the multiple factors that determine competitiveness. Second, it is necessary to define "competitive capacity" in terms that are relevant and operational for the purposes of the research, and identify the eventual changes in that capacity deriving from adoption of ITs.[34] Third, even the measurement of changes in productivity can present difficulties, particularly in the application of computers, since the latter "fundamentally change the way in which we work and in which we do business. We cannot compare the productivity figures of pre-computer days with those of today, since the computer allows us to do entirely different things" (Diebold 1990, p. 144).

This research should be based on the case-study methodology, and seek to identify both successful and unsuccessful cases. Among the hypotheses to be tested are the effects of scant prior knowledge and planning of companies regarding costs/benefits, installation time, etc., and the importance of the impact on quality and delivery times (in the case of MTCNC, for example). In particular it should examine the effect on the productivity of labour and capital and, as far as possible, on the profitability (the driving factor, according to received theory) of the adoption of new technologies.

Stimulus policies

The formulation of policies for IT diffusion has received very scant attention in the region. Below we suggest some subjects for research, based on the considerations indicated above. The subjects considered above (SME adoption of ITs and impact on competitive capacity) will have, as their main framework ,the studies on the economics of technological change, whereas the subjects proposed below (Access to information, Financing, and Training) require an essentially interdisciplinary approach, integrating the economic perspective with that of political scientists, sociologists, and specialists in education and in IT.

Access to information

One of the most common theoretical premises for diffusion actions is linked to the lack of knowledge of the potential users. It is assumed that diffusion is a process based on imperfect flows of information in an uncertain environment. Diffusion is not

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[34] A mandatory reference concerning this subject is the work by Porter (1990).

instantaneous because information is limited and the adoption of new technologies involves risks and uncertainty.

Different countries have implemented policies geared to improving information and the diffusion rate of ITs. One of the most interesting is, perhaps, the Microprocessor Application Project (MAP) in Great Britain, with a budget of 55 million pounds sterling, and a duration of ten years. The program centred on creation of an incentive for companies to analyze the introduction of microelectronic applications. The incentive took the form of payment to a consultant (up to 4000 dollars) and a subsidy of 25% of the cost of developing products involving such applications.

In the Federal Republic of Germany, since 1975, diverse programs have also been established to promote diffusion of electronics in small and medium companies, primarily through cooperation actions in R&D, for use of shared technologies, or support to individual companies. The Berlin Technology Centre, created in 1973, is an example along this line, as well as the Kernoforschungeszentrum of Kesruhe, for the area of CAD/CAM. In Italy, the National Applied Energy Enterprise has promoted CAD/CAM technology diffusion centres in the textile area.

Research should also be carried out regarding government intervention in this direction, in the light, on the one hand, of experiences undertaken in Latin America and other countries, and, on the other, the situation found in SMEs, as well as the perception business people have of the subject.

Financing

As we have seen, diffusion can be influenced to a greater or lesser extent by the availability of financing for new IT applications. Such financing can be granted to the IT supplier or to the IT user. The choice between the two systems poses complex questions of public policy (OECD 1987, p.59).

The granting of incentives to users has been adopted in several countries. In Japan, for example, the Japan Electronic Computer Company (JECC) has financed the sale of computer equipment to favour expansion of computer applications and, at the same time, the demand for equipment produced locally. In Brazil, the software law of December 1987 established incentives for purchasers of local software.

More research is necessary, on the one hand, on the impact of financing on the rate of IT adoption and, on the other, on the most appropriate mechanisms for financial or tax support. An analysis of the existing incentive systems as well as the effects of the policies applied in various countries, including those outside Latin America and the Caribbean, would be useful in this sense.

Training

Training for use of information systems seems to be key for increasing the IT diffusion rate and for encouraging efficient use of the resources employed. That training can be dealt with, even outside the formal educational sphere, on at least three main

levels:

* **General** awareness building: the objective is to familiarize the general public with computerized systems, by facilitating access to computers and standard software applications. Access to microcomputers and software at cultural centres, municipal centres, libraries, or youth clubs or centres has been dealt with in different ways in various developed countries (for example, France) and in some of the Latin American countries (Cuba, Uruguay, Colombia, etc.). These actions can be particularly important for promoting decentralization, exercise of democratic rights and other public policy objectives.

* **Training for IT use**: attainment of the advantages attributed to ITs requires much more than mere installation of equipment. It requires training of the potential user to make it possible to obtain the advantages the equipment offers. Despite the magnitude of the technological developments achieved, over the past decade the industrialized countries showed a slight increase in productivity. One of the causes of the so-called "productivity paradox"[35] would seem to lie, precisely, in the obstacles that must be overcome for absorption of the new technology. Not only has the new technology diffusion rate in factories (Unctad 1985, p.1) and in offices (Herald Tribune 11.3.1986) been lower than expected, but also its performance has in some cases given rise to considerable deception. According to the results of a Massachusetts Institute of Technology (MIT) study on computer use, "in reality..., the marginal dollar would have been better spent on inputs other than IT for production, such as non-IT capital." The interviews carried out suggested that much of the poor performance of ITs could be explained by inadequate organizational structures and by deficient techniques for budgeting capital expense. In many cases, the firms invested too quickly and more than necessary, without a cost-benefit analysis. How much of a change might there be in this situation, studied for a period in which mainframes prevailed, with the advent of PCs? According to the study, there is no a priori reason to extrapolate the results. But there is also "no evidence to date that the returns on IT have increased" (Loveman 1988)."

The objective of these policies is not to train specialists, but instead to provide training in IT use, including the capacity to select and negotiate acquisition of such technologies.

In the area described, substantial research is necessary, both regarding the experiences undertaken and the contents and strategies to be used at company-level and at other formal and non-formal educational entities.

* **User training**: Once a decision has been made to acquire IT, specific

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[35] See OECD, *Seminar on the contribution of Science and Technology to Economic Growth. Note by the Secretariat*, 9/6/88.

> problems arise regarding training for use of the system installed. The form of training is typically provided by the supplier of the equipment (or software) and is generally included among the supplier's contract obligations. Frequently, however, such training is insufficient, particularly because suppliers focus on the operation of the equipment itself, but do not provide training as regards the design and implementation of the respective information systems, or the development of the application engineering needed to install automated equipment.

In many cases, as a result of the lack of user training, modern equipment supports inefficient systems poorly adapted to real needs or, as we have seen, users face problems and delays in efficient operation of the resources acquired. Ruffier (1986) has clearly described these problems in various case studies in Argentina. User training should include management training to introduce the organizational reforms necessary to employ the new technology efficiently in the company.

Some of the questions to be addressed are: What type of training do suppliers provide? What training strategies are adopted at the level of user companies? What is the role of formal and informal education in user training? What are the relevant experiences in Latin America and the Caribbean? What programs arranged with companies can be designed to promote the organizational changes necessary to introduce IT? What personnel re-training programs are advisable?

Conclusions

The study carried out shows, in the first place, that the subject of technology dissemination holds a central place in the studies on the economics of technological change, which have made important contributions toward understanding the conditions that determine adoption of technologies and the way they are used. We find, however, certain lacunae, especially to link macro- and microeconomic analyses, and on the empirical plane, regarding the implications of adoption of technology on company profitability and competitiveness.

Second, dissemination has been studied from other theoretical perspectives, and efforts have been made to integrate the analysis of purely economic factors with organizational and social factors. These approaches considerably enrich the analysis of the subject and warrant further exploration.

Third, while the findings of studies on the economics of technological change are in general applicable to the dissemination processes in developing countries, a conceptual and empirical effort is necessary to fully understand that process in a context where imitative and incremental innovative processes prevail. Moreover, the problems of SMEs, whose main technological capacity lies in the management of production techniques, requires particular examination. There is a dramatic scarcity of empirical studies on innovation processes in SMEs in Latin America and the Caribbean.

Fourth, the analysis of the factors determining adoption of ITs in the industrialized countries provides a useful frame of reference for considering the subject. There are few studies on IT dissemination in developing countries, particularly in Latin America. The papers available indicate lesser intensity in the use of these technologies in the region, in comparison with the industrialized countries, and various problems for their implementation, particularly in the case of SMEs. These papers need to be updated and the information base (today highly fragmented) must be substantially improved. In fact, our current knowledge is very limited and insufficient for a definition of policies on the subject.

Fifth, the empirical evidence available on IT adoption by SMEs is severely limited, both from the sectoral and geographical points of view, as well as in terms of the types of technologies studied. Similarly, the few existing studies have concentrated on the factors for adoption (and, to some extent, on the effects on skills and work), but tell us little regarding the impact of ITs on company performance, particularly as regards their competitive capacity.

Sixth, it can be assumed that the current macroeconomic policies which, on the one hand reduce, in principle, the costs of equipment and, on the other, put SMEs in a more competitive context, increase the opportunities and incentives for IT incorporation by SMEs capable of surviving in this new environment.

Seventh, if we start from the premise that IT adoption can, under certain circumstances, contribute to better SME performance and to decentralization processes, it is necessary to investigate the role of public policies in fostering IT adoption. The studies available suggest market imperfections as regards access to information and limitations deriving from the availability of financing (although in some studies the latter does not appear to be a crucial factor). There are also deficiencies in terms of user training and the effect of organizational factors on the possibilities of profitable use of ITs. Public policies should contribute to correcting these imperfections, and to creating mechanisms to promote greater and more appropriate dissemination of ITs in SMEs, particularly through instruments favouring access to information, financing and training.

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Comments of the working group

Research recommendations

Investigation of various ways to address the **needs of SMEs** should be included: for example, by the establishment of information centres, IT demonstration centres, short-term consultancies to address specific problems, mechanisms to support the association of companies that work on the solution of common problems, etc.

It must be recognized that giving the user access to IT does not necessarily imply a benefit. Assumptions must be devised to assess the impact on **productivity** in order to determine the percentage of success achieved, etc.

An interesting sector where research can be focused is the **graphics industry**, which is characterized by including a large number of SMEs, and clearly needs IT.

Research methods

Even if high-quality information is not available, **existing information** is enough to determine the most applicable technologies and the mechanisms to implement them.

The **time factor** must be approached with caution, due to the speed of technological changes in IT, the learning curve times, the way IT is adopted, etc. On the other hand, tremendous changes in IT are foreseen during the next three of four years.

Knowledge gaps prior to research must be studied.

The following **tools** may be useful: chaos theory, case studies, and incremental research.

The issues of training, consultancy, and research must be fused into a single concept encouraging, as a result of their application, the **participation** of existing SMEs in the formulation of IT policies.

Caution is required when disseminating IT as the problem does not lie in the availability of financing for its set up. Several factors must be taken into account: the market environment, the production sector, the size of the company, etc.

There are two other aspects to be borne in mind:

the situation of the SMEs determines the cost-benefit ratio, taking into account the **environmental impact**; and

the scenarios where the company is not the one receiving the benefit, but rather the **society at large**.

Research context

Definitions

The concept of competitiveness has several meanings. One of them must be agreed upon in order to make progress with the research.

In terms of policies, the "policy" concept, together with the kind of policy we are talking about, must be clarified, for example, company policy .

Telecommunications

Since the study presented does not include specific consideration of telecommunications, the group offered the following details:

If the current legal framework of several countries is analyzed, one could reach the erroneous conclusion that there are similarities; they present, however, serious problems for implementation in terms of interpretation.

Telecommunications system operators are guided by the cost-benefit ratio; therefore, the access service to national data networks through public telephone dialling is the least developed method, since it is more cost-efficient for these companies to develop these services through dedicated lines.

Another important characteristic noticed is the fact that many telecommunications systems are set up using outdated technologies, that are not upgraded due to lack of interest, in spite of their low cost.

The telecommunications needs of SMEs are related to access to information necessary for business, and not, as in the case of big enterprises, also the need to communicate with their branch offices.

Document 09

Information Technology Policy Research, Training, and Education

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Introduction

This paper has been prepared for discussion at the IDRC Conference on "Information Technology Policy for SMEs in Latin America and the Caribbean", in Montevideo. It deals with topics related to policy implications in education and training, in order to help develop a Research Program.

Information technology's main role is to assist industry and business in the production and trading of goods and services. To be able to accomplish these goals, SMEs' human resources must be trained to make effective use of technology. Information technology (IT) introduction in business is a process of progressive change. Though there are several factors to consider in this process, the effect of change on human resources is one of the most important.

The ability to properly manage available technological capabilities to attain business goals, and ensure their development and growth, depends on management's expertise in capitalizing on technological opportunities. Management has to select the most appropriate course of action among many possibilities.

Policies in information technology training for SMEs

Education and training policies in Information Technology are of special interest to Latin American governments since IT became an important issue in their economies. All of these policies refer more to public administration than to the private sector, and most of them mention training.

In ALADI (1986), six of eleven countries in Latin America cited the need for training in IT, for example:

" Promote the study and development of the use of computers:.." ACUC, Colombia

"Promote and encourage executive training ...." ABBES, Brazil.

"Promote and encourage training of executives, technicians and associated workers..." ASBEMI, Brazil.

In all cases, they wished is to support IT training, but concrete ways to achieve this did not exist, particularly for SMEs. Chile, Brazil and Argentina showed a special interest in the development of software and hardware enterprises, but their policies were aimed at building up an informatics industry. Uruguayan policies in IT were in a process of transition. That process has still not been formalized, but policies on training in both public and private sectors will be a high priority.

To sum up, Latin American policies for IT training, and, in particular for SMEs, are not clearly defined. At best, they form part of the rationale behind national IT policies.

The business context in the information era

The introduction of new technologies in a business affects the organization as a whole. It causes substantial structural changes, especially related to the effective use of information as a strategic resource. The complexity of IT, its wide range of application, its potential to generate value added, and its adoption in all fields, are altering the nature of work in business, and facilitating new educational, social, economic, and political forms.

During the last three decades, IT in business has significantly affected all personnel no matter what their position. It has given new work opportunities and new challenges to management and to consultants, especially those in the IT business.

In a knowledge-based society, information is one of the major resources needed to understand the advantages that the technology offers, to adapt them to the organization, and to avoid the confusion which can arise from inadequate implementation.

This situation is of interest to SMEs which are looking to regional integration as a major factor in their development, and IT as a way or a tool to obtain it. In that context, for SMEs to be effective, they must have employees trained to understand the wide range of opportunities and problems related to the use and management of IT, and the help that national and regional policies can give them.

Non-IT SMEs and IT SMEs

All that has been said so far is valid for all SMEs, no matter what their field of development or production. It is now necessary to make a distinction between the IT SMEs and Non-IT SMEs, because, in terms of training, they face different needs and problems. IT SMEs are those that produce IT goods and services while Non-IT SMEs do not.

Non-IT SMEs

For Non-IT SMEs, IT is a working tool, and it can be considered as a service or simply as another area of the organization.

At the Master in Education Department in the Catholic University in Uruguay, UCUDAL (Caffarini 1993), research is taking place on "The use of IT in Non-IT SMEs". The study is for a Master's thesis, and its goal is to determine a base-line for the development of IT training courses to update executives.

The following tables summarize some of the results of this study, based on a sample of 132 executives. Tables 1 and 2 show the opinions of these executives as to the usefulness of IT in SMEs.

Table 1: Executives' opinions on the competitive advantage of using information technology for strategic planning in small and medium enterprises in Uruguay Caffarini, S., Montevideo, 1993.

Opinion	% of respondents
Very positive for the business	5
Can lead to improvements	32
No benefit	63

Table 2: Executives' opinions on the applicability and influence of information systems in different business fields in small and medium enterprises in Uruguay Caffarini, S., Montevideo, 1993.

Opinion	Business field		
	Production	Organization	Telecomms.
	% of respondents		
Should be considered	82	94	53
Certainly applies	17	48	9
Influence is very good	na	17	na
Influence is good	na	31	na
Influence is not known	na	52	na

na: not available

Of the 132 executives, 82% declared that at least one person at the SME had taken one course in IT. Tables 3 and 4 give details of this training.

Table 3: Executives' opinions on the quality of training in information technology in small and medium enterprises in Uruguay
Caffarini, S., Montevideo, 1993

Opinion	% of respondents
Very good	27
Good	64
Poor	9

Table 4: Administrative levels of trainees in information technology in small and medium enterprises in Uruguay
Caffarini, S., Montevideo, 1993

Level	% of respondents
Executive	8
Middle management	9
Operational	83

From this data, we can infer some estimates applicable to Uruguay.

From Table 1, we note that there are few SMEs that use IT as a real tool for strategic planning, and thus they do not consider it a tool that can give a competitive advantage. To further develop this point it would be necessary to consider two aspects:

- the extent that SMEs, especially those with lower income, use planning to develop their activities;

- if their executive and management levels are IT users, or if IT is developed only at the operational level.

From Table 2, we see that more than half of the executives could not determine the

influence of IT on the organization of their enterprises.

The study also included a non-structured interview at which further information was gathered.

Regarding training, all agreed that their SMEs have a permanent need for:

further training of their personnel in new IT products,

training for new workers, and

training of executives and managers in use of new technologies as business tools (trading, production).

Regarding existing computerized systems:

most are in the field of administration, mainly in accounting and invoicing;

72% were purchased or designed outside the SME, without the cooperation of the SMEs users;

92% use at least a word processor; and

78% use at least an electronic spreadsheet.

Of particular interest is the observation that most of the systems have been designed without SME participation, for this implies that there may well be discrepancies between the data processed by the system and information useful for decision-making.

The interview also showed that all of them are conscious of the need for training in IT, and they have made efforts to obtain it with the educational resources available. It showed, too, that the executive and middle management levels have not been trained widely, and that they have the feeling of being unable to keep up with the rapidly changing technology.

It should be noted that this research is applicable only to Uruguay because it was designed to help the University determine the educational needs of the public in that country.

This does not prevent theoretical generalizations in a global context at the regional level. For example, in IT congresses and exhibitions (Comdex'92, Fenasoft'93, Fenamerco'93) in Brazil, CLEI'93 and USUARIA in Argentina, in the Mercosur study groups, etc., the essential thrust of the conclusions was similar. Numerical differences, which themselves are worthy of investigation, were revealed. However, in general, they show that the levels of education and training are closely related to the capacity of regional decision-making.

IT SMEs

The case of Information Technology SMEs in respect of training in informatics is very special because informatics products are their main output. Training and education are essential determinants of their production quality.

Most of their training is done in basic, low-level IT products. They have to search constantly among and try out a wide range of options, with an effect difficult to determine on their development and design budgets. At the same time, IT SMEs have the same training requirements as other enterprises in such areas as marketing and commercialization, that are more critical for their growth than IT training itself.

The IT training market in Uruguay

A market study, done by the IT Department at UCUDAL in 1990 (Caffarini 1990), with the goal of determining the characteristics of the personnel that needed non-formal training in IT, gave the following results.

The study was done at two levels in the organization: management (executives and middle managers) and operational. It considered, also, the variables age, sex, and formal education.

Of all the persons interviewed, 17% were in the management level (age 26-45 years) and 83% in the operational level (age 18-35 years).

Table 5: Distribution by sex of workers in Uruguay at management and operational levels, according to formal educational qualification
Caffarini, S., Montevideo, 1990

Sex and formal education	Management level	Operational level
Male (total)	89%	93%
Degree	22%	6%
Degree studies	35%	51%
No Univ.	43%	43%
Female (total)	11%	7%
Degree	52%	12%
Degree studies	27%	56%
No Univ.	21%	32%

From Table 5, firstly, it must be pointed out that the population to be trained is mainly male at both the management level and at the operational level.

Secondly, women, both at management and operational levels, have, on average, a higher formal educational qualification than men in the corresponding posts.

At the management level, most had studied administration. Nevertheless, only 22% had a post corresponding to the studies they had done.

The average age is 28 years. The ones between 30 and 35 were the most interested in attending a one year-course.

Education available

The education available consists of undergraduate and graduate programs, in public and private universities, in academic and research organizations.

There are various ways to try to reach the training goals, some more promising than others. Mexico has given an important role to the undergraduate and graduate studies in IT and computer science, going from 15 programs in 1974 to 114 in 1983, though we were unable to determine how many of them correspond to training for SMEs.

In Uruguay, there are:

- Two universities (one public and one private) with two undergraduate programs and one graduate program in computer science. There are IT topics in the undergraduate courses of Economics, Administration, Law, Engineering, Chemistry and Basic Sciences.

- Academic schools that offer training specially for management people. (ORT and EI).

- International cooperation supporting executive programs, for example Empretec of PNUD.

- National business associations giving training for their associates. (ACDE, SOFTWARE CHAMBER).

In all cases, there is cooperation between the SMEs and the universities or schools. That is so at the Universidad de la Republica in consulting and counselling, the IGE in the UCUDAL with the support of the EEC, or the Empretec program with both universities and public/non-public organizations. A similar situation is observed in Brazil with the Universidad Rio Grande do Sul (UFRGS) and SEBRAE with the Empretec program, and is also developing in Chile.

Education available is strongly related to the market needs and to the national policies for production and business development in the country. However, in the IT arena, the business sector is in advance of existing policies. While the national policies have been defined by the major economic interests in the country, the Latin American IT SMEs have avoided national policy constraints by building up technological network alliances in the form of partnerships or joint-ventures, in some cases with government support, and in others by their own developmental capabilities.

In that context, the enterprises are uniting and modifying the technologies to gain a foothold in the global markets, with the support of telecommunications. With growing IT complexity, economic requirements, know-how, and expertise became the most important factors.

National policies for SMEs' training cannot change at the same speed as the market, so such policies do not fit the needs properly. In general, they are not explicit enough regarding IT, but are more concerned with economic, industrial or trading issues.

Private sector organizations that offer higher level studies have the greatest possibility of satisfying SME training. In that context we propose new educational methods and methodologies that can meet SME needs for IT education, taking in account the regional markets.

The new business style

Traditionally, enterprises acquired a hierarchical and closed organization style. This is now giving way to a new style where an "open network" is the main thrust. Some of them have begun that process of change while others are in a crisis, not knowing the best path to follow. Really, none of them has yet found an adequate model.

The change is multidimensional and introduces new topics. The new style can be defined as an open network, because it is a transformation that goes from a hierarchical multilevel organization to a distributed, interrelated, networked group (Tapscott 1993). The new organization is dynamic, based on work in teams instead of a static organization, where the decisions are made most of the time by middle management.

The changes are not only internal. This concept can be applied to new relations with the customers and suppliers, and also to defining the role of a partner.

The main preoccupation of business is no longer capital, though that still is a major issue, but human resources and IT resources. The idea of a group of workers striving together with a united horizontal vision of the enterprise is taking the place of the manager-centred picture.

In this type of organization, people are driven to act with responsibility and creativity, free of bureaucratic control, shouldering the risks of their actions, that still must, however, fit the business goals. A new type of work-training is emerging, multidisciplinary and interdisciplinary.

These changes are possible thanks to technological factors that favour the new business style, based on the capability to work with appropriate and timely information. IT offers the tools that facilitate rapid communication between people, even if geographically dispersed.

The educators' goals in this environment are to understand the new global business model. Teachers are in a situation without an historical parallel. They can design their courses only on the basis of emerging experience and research.

Strategies for teaching and training in a new business era

Permanent training and technology updating in IT for SMEs can also be done using new IT-based tools: Educational Multimedia and Intelligent Tutoring Systems.

Educational multimedia

Educational Multimedia arises from the joint use of interrelated technologies and methodologies, that have evolved recently because of the convergence of new technologies in instruction, computing, and audio/video media, as well as a development context in which the use of new tools has become feasible.

Education has traditionally focused upon the delivery of instruction to groups of learners. Advances in instructional design methodologies have allowed the educational process to also focus on the individual learner.

This new method of instruction is used for topics where there is a need for specific training about the enterprise, work methods, and particular products.

Five forms of individualized training that have evolved since 1950 have been described: self-study, programmed instruction, computer-assisted instruction, computer-managed instruction and multimedia instruction. The last one integrates the features of computer-assisted instruction and on-line multimedia equipment (computer, video, and sound).

The main technological elements that facilitate Educational Multimedia are the videodisc player and significant advances in microprocessors and work stations.

From the educational point of view, this opportunity is a big challenge for teachers, not just for the content but for the form in which the content must be presented to the learner. It does not mean transcribing a book onto the computer, it means considering the content and the form in a new context, more complex than the blackboard, the whiteboard, the paper and pencil.

Educators are used to giving classes as lectures, where they can impose their style and presence on a group of students. Educational Multimedia is addressed to the person that manages his or her own learning, and that needs the material to be designed, prepared,

checked and implemented, allowing for individual characteristics of the learner. Interaction will not be managed by the teacher in class, it must be integrated into the multimedia system.

A considerable amount of application of this new technology will be necessary in order to be able to evaluate the results. The cost/benefit ratio of this educational form in the production and business arenas will be governed by its advantages: shorter training time, better performance, on-demand availability, and direct use in the workplace. The cost of the technology is not easy to evaluate because the equipment used can be shared by other functional areas of the enterprise. These cost/benefit issues are different from those applicable to formal education.

Educational Multimedia has been used at the University of California at Fullerton to teach WordPerfect, Lotus and Dbase where 100% of the students argued that it is easy to use and 87% recommended it be used.

The development and use of Educational Multimedia offers challenges to educators and IT professionals alike. Both groups working and researching together can bring success or failure to the application. SMEs will adopt it if they find a tangible benefit and their trainees feel comfortable using it.

Intelligent tutoring systems

The demand for IT training at all levels of organizations, SMEs included, exceeds the capacity of educational institutions to supply it.

Verstraete (1993) indicates four ways to help with the problem: distance education (using video-conferences), computer-aided education, expert systems and intelligent tutoring systems.

The Intelligent Tutoring System (ITS) is a consequence of the application of artificial intelligence to education. ITS methodology is based on the experience in applying expert system (ES) ideas. An ES is used for solving problems in a specific field called a domain. Although expert systems were not built for education, their power to solve problems helps the student acquire expertise in a concrete situation.

Expert Systems are designed to help users solve one specific problem at a time, and not a complete class of problems.

An ITS is designed to effect knowledge transfer in a particular defined domain. It is a bridge between computer-aided education and ES.

The main difference between computer-aided education and ITS is that the latter uses information gathered about the student during the course of the training, to prepare and present the next stage or instruction section. It is dynamic, depending upon the user's previous performance. That is possible thanks to the ES within the ITS, whose rules are

dictated by the instructor or the teacher.

The "intelligence" is used to detect failures, to indicate their possible causes, and to give a strategy to help ensure they do not occur again. The capacity for intelligence also gives flexibility in dealing with different cultural contexts.

Another feature is to present dynamic situations where the user can simulate different scenarios to apply his/her knowledge that has been acquired in different domains.

Educational Multimedia and Intelligent Tutoring Systems are no panacea. They are not easy to develop, they are expensive, and trainers are not accustomed to using them. Nevertheless, they are a new way to advance training, and SMEs can consider their adoption in terms of economics and growth, being conscious that those issues depend on training and education.

Curriculum aspects in the development of IT training

Curriculum aspects should be considered in both the technological and the business fields.

In the **technological field**, important aspects are:

Course	Technological topic
MIS	Multimedia capabilities
	Communication technologies, technical aspects
	Kinds of users
Databases	Databases for new technologies (Multimedia, intelligent tutoring systems)
	Object-oriented DB
	Intelligent DB
Software Engineering	Multimedia applications design
	Hardware and software for multimedia
	Artificial intelligence design
	Expert systems design
Telecommunications	Available technologies

	Selection of the service type
	Planning for different modes: centralization, decentralization, distribution, client-server, etc.
	Development and implementation of networks
Communications	Communication technologies and their implementation
	Hardware and software, design, standards, integration
	Implementing an organizational communications infrastructure.

In the **business field**, at least the following are required:

Field	Topic
MIS	The role of technology and the role of technologists
	Data access
	Infrastructure: awareness of problems and differences
	Management of costs and benefits
	Ethics, alternatives, risks
Database	Access policies
	Responsibility in the application and in business policies
	Multicultural applications.
Software engineering	Measures of systems effectiveness
	Systems in the organization: change and integration
	Management of cultural differences
Telecommunications	Available technologies
	Capability to evaluate technologies
	Evaluation of tangible and non-tangible costs, risks, and benefits

Communications	Communications evaluations in the organization
	The availability of new opportunities to the organization

Final considerations

This paper had presented some issues that are significant for IT training in SMEs.

The possibilities offered by the technologies advance faster than the rate at which SMEs can introduce them as elements of competitive advantage to develop production and commerce. Those different rates are, in great measure, caused by training problems.

IT opens up a new and different opportunity and challenge to the business world. In order to take advantage it, formal and non-formal education must research and develop new educational methodologies based on the technology.

The role of the IT technologist is to develop applications and tools, the educators to apply them, and the business sector to make the most of a new era in the training of their personnel.

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Appendix

ACDE. Asociacion Cristiana de Dirigentes de Empresa.

ALADI. Asociacion latinoamericana de Integracion.

ACUC. Asociacion Colombiana de Usuarios de Computadores.

ASBEMI. Associacao Brasileira das Entidades Municipais de Informatica.

Empretec. Programa para el Desarrollo de Empresas de Base Tecnologica.

ORT. Institucion de ensenanza en Informatica y Empresas. Uruguay.

PNUD. Programa de Naciones Unidas para el Desarrollo.

UFRGS. Universidad Federal do Rio Grande do Sul.

UCUDAL. Universidad Catolica del Uruguay. Damaso A. Larranaga.

Comments of the working group

Research recommendations

Subjects on which there was agreement that research is needed in relation to training and the SMEs comprise:

definition of requirements (needs);

definition of contents;

definition of adequate pedagogical methods;

access pathways for dissemination (how to reach a larger number of SMEs more efficiently);

training programs supporting measures, promoting the training of the entrepreneurs of the future from their very first contacts with the national education system;

self-assessment and feedback systems;

training methods in the areas of:

updating (recycling),

initial IT training, and

on-the-job training

The search for the most adequate methodologies continues to be one of the greatest challenges.

A fundamental guideline for all work in education and training must be based on reality as actually seen from the SMEs. This implies starting at the SMEs and moving upwards.

In relation to financing policy, the results of the experiences conducted with the object of obtaining credit, tax benefits, subsidies, etc. must be studied in relation to the training activities of the SMEs.

Training activities may also be oriented towards the area of consultancy, which generally originates in the academic sectors, with very little or no networking experience on SMEs.

Research methods

Bear in mind the following methods of gaining access to the SMEs:

point out the benefits (process automation, company's data processing oriented towards GIS, etc.);

investigate two levels of training:

managerial awareness, and

training of an operational team;

facilitate contact between SME managers and IT suppliers.

The supply of IT training in Latin America has a lot of room for improvement. The services do not generally satisfy the immediate requirements of the SMEs. Experiences such as SERCOTEC and SEBRAE must be studied and if possible reproduced.

Research context

An inventory of training and consultancy services for IT in the region should be set up, for SMEs that cannot find an answer to their questions in their communities or countries.

Training in IT must be encompassed in the wider area of training for technological management in order to obtain more global results.

Since the company manager is the result of the general education system of the country, IT training should be articulated within the policy of the National Education System.

Even without research, the following action proposals are addressed to various groups:

government and its institutions,
universities and formal training institutes,
collective organizations of SMEs, and
research organizations.

The proposals can be summed up as follows:

organizational:

form entrepreneurial groups,

form company incubators;

policies:

government (on training), subsidy financing,

company strategy for IT training;

methodology:

research,

intervention;

training:

in-company training,

inter-company training,

at government level;

software development:

sensitization,

application.

Regarding the latter point, software production cannot be launched without previous assessment of the customers' potential and the contents that will be included.

Document 10

Effectiveness of Information Technology Policy-making about Small- and Medium-sized Enterprises (SMEs): The Case of Brazil

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Introduction

The establishment of guidelines regarding the development and utilization of information technology (informatics) by the Brazilian government goes back to 1972. In that year, the Government began the coordination of electronic data processing activities (CAPRE was the Portuguese acronym for the coordinating body). Its main objective at that time was to put order in what was considered to be an irresponsible waste of money by different government authorities, who were establishing a number of data processing centres. This resulted in CAPRE being given the power to supervise the data processing centres in the federal administration, to authorise the establishment of new ones, and to oversee the acquisition of hardware and software. Its scope was widened in 1975 when it became responsible for the clearance of all imported information technology, both by the public and private sectors.

By 1976, CAPRE had reached the dominant position it would maintain for the next fourteen years (later CAPRE was replaced by the Secretaria Especial de Informática (SEI)). In that year, it was assigned the mission to study and propose guidelines for the setting up of an explicit national information technology policy. The objectives of this policy were:

- to provide the country with the technological capacity to design, develop and produce hardware and software;

- to create mechanisms that would lead enterprises with nationally controlled capital to a predominant position in the market;

- to create jobs for technicians and engineers;

- to achieve a favourable balance of payments in terms of information technology products and services; and

- to create opportunities for the development of an industry of parts and components for information technology.

The decision was taken to protect the domestic companies producing small

computers and peripherals and to prohibit the import of similar products. In some aspects this policy was similar to other policies which were adopted in the process of industrialization of the country. The need to achieve equilibrium in the balance of payments was the main justification which led to the adoption of policies of substitution of imports and the resulting decision to create barriers to the import of products that had similar ones locally produced. At the same time, different kinds of financial incentives were established to foster the production by national entrepreneurs of those goods covered by these protectionist rules.

The information technology policy adopted in the 1970s soon had to face the pressure of the United States government and the American computer industry. Similar pressures did not occur when the automobile industry was established in the 1950s, under the protection of severe restrictions on importation of similar products, probably because the automobile industry was dominated by multinationals. Indeed, even today, that industry is almost 100% controlled by a small number of companies (American, German, Italian and Swedish), which strive to prevent the entry of foreign competitors.

In 1984, an act approved by the National Congress consolidated in a comprehensive National Informatics Policy most of the various decisions that had been taken by CAPRE, from 1972 to 1979, and by the Secretaria Especial de Informática (SEI) from 1979 to 1984. This act, commonly known as the Lei de Informática (Informatics Law), defined informatics activities as those activities related to the 'rational and automatic processing of information', in particular

a) research, development, production, import and export of electronic and optoelectronic components;

b) research, import, export, manufacture, commercialization and operation of machines, equipment and devices using digital techniques, for the collection, processing, structuring, storage, switching, retrieval and display of information, as well as their respective electronic and other parts and components;

c) import, production, operation and commercialization of software and respective documentation;

d) construction and utilization of databases; and

e) the rendering of technical services in informatics.

The principal instruments to implement the informatics policy were:

a) stimulus for the development of informatics activities in the country;

b) the establishment of standards for quality certification of products and services;

c) the controlled use of public funds to promote informatics activities;

d) manpower development;

e) the concession of fiscal and financial incentives to national enterprises in order to develop informatics activities;

f) the control of imports of goods and services for eight years from the date of the law;

g) the adoption of standard protocols for data communication; and

h) the establishment of programs by state-owned financial institutions to support the development of informatics activities.

Item e) was the dominant issue in all discussions, before and after the law was enacted, casting a shadow over the variety of objectives which envisaged the creation of an autonomous sector of this new technology in the country. Soon this law was known as 'the law of the reserved market' (lei de reserva de mercado).

In 1990, after the election of a President of the Republic who claimed that 'modernity' required competitiveness and the opening of the market to foreign manufacturers, the SEI was closed down and the process of changing the informatics policy was begun. To a certain extent, this change was facilitated by the eight years deadline established in the 1984 law, which was due to be reached in October 1992.

One year before this deadline, a new law was approved by the Congress (Law no. 8,248, of 23/10/91) on the opening up and competitiveness of the informatics and automation sector. This law was approved under the terms established in the Constitution of 1988 which defined a new typology of economic organizations. Consequently, the 1991 law reduced from 70% to 51% the minimum threshold of capital control for an enterprise to be considered a 'Brazilian enterprise of national capital'. This condition is a pre-requisite to apply for protectionist measures and benefits granted by the state.

However, under some circumstances, even firms that do not fill the requirements of a 'Brazilian enterprise of national capital' can apply for such benefits, in the area of informatics, provided they can show that they are maintaining a) effective training of technical staff in the technologies of product and production process, b) research and development programs in the country, and c) continuously increasing programs of export of informatics goods and services.

The main characteristic of the 1991 law was to confirm the end of the reserved market policy and the implementation of a policy of stimuli (as defined in the decree no. 792, of 2/4/93) to support the development and consolidation of the domestic industry.

These stimuli included:

a) exemption from the tax on manufactured goods for all informatics and automation products made in the country by companies complying with the requirements of the 1991 law;

b) a 'buy Brazilian' clause, determining that the public sector should give preference to products manufactured by Brazilian enterprises of national capital;

c) the national enterprises should have priority for funding from federal financial institutions;

d) up to 50% reduction in income tax on those monies spent in R & D;

e) up to 1% reduction in income tax on the money spent by legal entities in the acquisition of new shares of national firms in the informatics sector.

It must be emphasized that, although the import of information technology products is no longer forbidden, there are an import tariff and other taxes which can double their price in relation to the prices in the country of origin. There are indications, however, that both foreign and local products have had, during the last twelve months, a steady decrease in their retail prices, probably due to increased competitiveness. It is reported that from January 1992 to February 1993 there was a 56% decrease in the price of 386 SX microcomputers in the internal market.

The smuggling of microcomputers (not to mention software) was a common practice. It is believed that the majority of personal microcomputers installed in homes or small and micro enterprises found their way into the country through smuggling. They came as original equipment or parts that were assembled in 'backyard workshops', a practice which still exists, although somewhat restricted to less powerful machines. Some specialists estimate that the amount of smuggled equipment is probably twice the amount of equipment produced by the formal sector.

The smuggling of software and the proliferation of pirated copies was and still is intense. Microcomputers assembled in backyard workshops are sold with pirated versions of DOS, Windows and the like. There are resistances against these practices. The local production of software has been growing very fast and the national association of software producers is one of the groups struggling against software piracy. The proliferation of software viruses, the opening of the market to software imports, and the rapidly increasing production of domestic software, are factors that will probably contribute to the reduction of smuggling and piracy.

The main achievements from 1972 to 1990

Before the intervention of the state, the information technology sector was completely dominated by foreign corporations. IBM established its first plant in Brazil in 1939 to produce industrial clocks, typewriters and punched card equipment. In 1961 it started to assemble in Brazil the 1401 computer. Burroughs started the operation of its plant in 1967, producing accounting machines and computer peripherals. Control Data, Data General, DEC, Fujitsu and others also established local representations to market their imported products. In the beginning of the 1970s Brazil was among the top ten markets for data processing equipment in the world, a position which it still retains. In 1992, the

Brazilian informatics market was equivalent to 3% of the Gross National Product (GNP), i.e., US$ 8.5 billion.

When data processing equipment was synonymous with what we now call mainframes, it looked as if this industrial sector would be forever dominated by a small group of multinational or transnational corporations which held the required technological capability and the huge investments required. It was the advent of the mini- and microcomputers, and the consequent spread of their use, which established the conditions under which it was feasible to consider a domestic informatics industry, outside the control of the big multinationals.

In 1976, 90% of the computers (mainframes) installed in the country had been supplied by four American companies, IBM being the leader with 63% of the equipment installed. However, in the late 1980s, national companies held 60% of the market.

The national informatics industry, which was created under the protection of the reserved market law, covers a broad range of products and services: microcomputers, minicomputers, peripherals and components, banking automation, equipment for digital exchange and data communication, industrial automation, semiconductors, printed circuits, liquid crystal displays, optical fibre, software, digital instrumentation, and technical services.

In 1990, there were 125,000 employees in the information market: 58% in the industrial segment and 42% in the technical services sector. Until 1987, the percentage was larger in the technical services segment than in the industrial sector. Of this total, 73,000 were employed by national enterprises. In the same year, approximately 40,000 employees had a university degree.

Although a decrease in investments in manpower training and development had been noticed in 1990, until 1989 there were significant investments, with an average yearly increase of 45% between 1986 and 1989. The national enterprises spent in 1988 and 1989 US$ 54 million and US$ 78 million, respectively.

In 1988, a program was set up to promote manpower development in several strategic areas, including information technology. This program - RHAE (Formação de Recursos Humanos em áreas Estratégicas) - had awarded, from 1988 to 1990, 1,941 scholarships. The academic community received 819 (42%), the entrepreneurial sector, 597 (31%), and the government sector, 525 (27%). These scholarships include post-graduate training in different levels, from in-service training to post-doctoral research. With the exception of the scholarships for in-service training, refresher courses and specialization, all took place in the country.

When the reserved market policy was abolished, in October 1992, an information technology industry existed in the country with a predominant participation of national enterprises. However, their capacity to compete with imported products, not only in terms of prices but also in terms of technology, proved to be unsatisfactory. As a result, national manufacturers had to adopt new strategies to cope with this new situation.

Some companies merged, others became distributors of imported equipment and some restricted their participation to very specific applications. Changes also occurred in the area of mainframes, with the competition of foreign enterprises which had not had access to the domestic market because of the protection, including those companies that assembled mainframes in the country under the terms of the reserved market policy.

As stated in a recent report, the most dramatic changes took place in the local production of peripherals:

> Without the protecting shield of the reserved market, several domestic enterprises, that had made big investments to produce magnetic disks and printers in the country, were forced to close down. Or they simply had to move to another line of business to avoid the worst.

The same report goes on:

> IBM also had to face big problems in the area of peripherals with the end of the reserved market. Under that policy, the IBM subsystems of magnetic disks of large capacity were protected against similar imported products because they were locally produced. Without the reserved market, competitors cropped up almost overnight: Fujitsu, Memorex, Telex, EMC, Hitachi.
>
> Other problems, no less complex, were added to the very strong competition in the information technology area. For example, enterprises had no way to avoid the direct impact of a very high inflation rate.
>
> There was also no way to avoid the effects of the economic recession, or the effects of the political crisis consequent to the impeachment of the President of the Republic last year [1992].
>
> Against such a background, therefore, unsurprisingly, very big operational losses were commonplace, which pushed debts to stratospheric levels. (...) Last year financial data reveal in general that enterprises which have activities related to computers in Brazil still show a modest profitability when compared with other economic activities. The origin of all this seems to be the low capitalization level which results in excessive financial costs.

Despite such gloomy considerations, access to information technology and its utilization has enormously developed. The fairs and exhibitions that take place in different cities every year receive hundreds of thousands of visitors and the sales of hardware and software on these occasions are impressive. For example, the 7th Fenasoft (International Fair of software, hardware, and informatics services), which was held in São Paulo last July, received more than 500,000 visitors during four days. Sales are reported to have reached two billion dollars.

Another example is given by a national firm (51% of national capital and 49% of multinational capital) which occupies the 47th place in the ranking of the 100 biggest informatics companies. In 1992, it produced 1,100 microcomputers per month. Last September, the average sales had reached 2,500 machines per month. The same company

was investing US$ 2 million to improve its production plant in order to obtain ISO 9000 certification.

Users of microcomputers have access to financing of projects for the acquisition of hardware and software. The Federal Savings Bank (Caixa Econômica Federal) is offering loans to be paid in 15 monthly instalments at the interest rate of 2% per month plus the monetary correction. Loans can be used to buy microcomputers, notebooks, fax machines, printers and copiers. Another state bank, the Banco do Brasil, as well as some private banks, offer similar credit lines.

Last October, a big sale was held for one week in Rio de Janeiro with the objective of selling information technology products at a price 30% lower than the regular price. University students, professionals, and small enterprises were the target clientele, to whom a private bank offered a special credit line.

Despite all these advances, the degree of utilization of microcomputers by the population is low: six computers per 1,000 population, a figure which is far below Argentina (12), Chile, Venezuela and Mexico (16), Japan (83) and the United States (243) (see Computer Industry Almanac 1992).

The software industry has shown a steady growth. In 1986 FINEP, a federal funding agency, initiated a program (Programa de Apoio ao Software) which finances software development under extremely favourable repayment conditions.

A national program of incentives for exporting software (SOFTEX 2000) was recently set up with the aim of raising to 1% the Brazilian participation in the world market. Thirteen cities have joined this program. It is expected that it will create 50,000 direct jobs and about one million indirect jobs.

Telecommunications and access to information

Telecommunications is a state monopoly. There are 27 regional telephone companies responsible for the operation of local services under the coordination of a holding company: Telebrás. Long distance calls, both domestic and worldwide, are operated by Embratel. There are more than 12 million telephone terminals (seven telephones per 100 population, what places Brazil in the 42nd place in the world ranking, whereas in 1978 it occupied the fifth place). It is expected that in 1994 the number of installed telephones will increase by 1.2 million. Investments in the expansion of services by Telebrás were US$ 3.06 billion in 1992, 3.25 billion in 1993, with a forecast of US$ 3.20 billion in 1994 (the desired figure would be twice this amount).

Cellular telephones (200,000) are available in major cities. This is an area which is growing very fast (a total of 1.5 million users is expected for 1995), although the tariff of this service is high in comparison with the common telephone.

In 1985, the first telecommunications satellite (Brasilsat 1) was launched into orbit.

The satellite was built by a Canadian firm and launched by the French Arianespace. The following year Brasilsat 2 was launched.

Public data communications network

The Rede Nacional de Comunicação de Dados por Comutação de Pacotes (RENPAC) is a countrywide network which is based on the X.25 protocol. RENPAC can be accessed either by dedicated circuits or by telex.

The public network of telephone dialled lines permits asynchronous linkages in 1,200 or 2,400 bps for data communications at a cost similar to voice transmission. Transdata (dedicated lines) permits the establishment of point to point or multipoint data communications network countrywide, both synchronous (2,400, 4,800, 9,600 and 19,200 bps) and asynchronous linkages (1,200 and 2,400 bps).

Interdata is the international data communications network which covers more than 60 countries. It works as a gateway between RENPAC and international networks.

RENPAC provides access to a range of databases operated by domestic and international information brokers. Services such as Dialog, Orbit, Oceanroutes, BRS, Questel-Telesystemes, STN International, DRI, EMIS, MDC, Reuters, Tradstat, Easynet, Answer Bank and CompuServe are available.

The scientific and academic communities have access either to international networks, such as BITNET, Internet and AlterNex, or to such national networks as RNP (Rede Nacional de Pesquisas) and Rede Rio.

The Sistema de Tratamento de Mensagens (STM-400) is an electronic mail service which complies with the X.400 protocol. It has national and international coverage and can be used to send and receive messages between computer terminals, telex and fax users. The services available through STM-400 include such facilities as BBS, computer conference, information and software banks.

The Serviço Público de Mensagens (SPM) is a facility which became available recently. It is tailored to serve persons who have great mobility and receive messages from their clients, and even by those who do not have a permanent office or a private telephone line. It is a sort of blend between an electronic mail and a paging service, with the advantage that the user sends or receives messages through common telephones, including public phones. One of the modalities of this service is the so-called 'virtual telephone' for clients who do not have a telephone line. In this mode, the subscriber is given a number of his own which will appear in the telephone book and in commercial information. From any telephone, including public phones, the subscriber can receive a message through a system equivalent to an automatic telephone answering system.

Another recent development are the 'centros de telesserviços comunitários' or 'telecentros' which make available to the community at large the services provided by information technology and telecommunications, with emphasis on economically and socially isolated communities, including the rural areas. The 'telecentros' will provide four services, namely:

Public services - make available to users, at one point, several services, such as information on water and electricity supply, telephones, mail, basic sanitation, public health, banks, etc.

Teleoffice - this service offers the basic facilities of an office, including telecommunications, public phones, fax, typewriters, copying machines and information technology resources, such as microcomputers with text and graphic software and printers. The telephones will have individual dialling numbers that can be used personally or by professionals and firms.

Business applications - oriented to support small and micro enterprises in several areas of the economy in order to improve their performance.

Educational applications - oriented to support the local educational authorities and schools, teaching students and teachers how to make use of information technology resources both at the literacy stage and in other educational processes.

The SME sector

In 1990, the number of industrial, commercial and service enterprises was around 3.5 million. Transportation, building, communications, financial institutions, public administration and agriculture enterprises were not included in this figure. The micro-, small- and medium-sized enterprises accounted for more than 99% of the industrial, commerce and service establishments. The micro-sized enterprises accounted for 82.8 % of the industrial sector, 90.9% of the commerce, and 93.5% of the service sector (SEBRAE 1991).

The importance of SMEs in Brazil is also evident from other indicators. They are responsible for more than 84% of the revenue of the commercial sector, 66.3% of the revenue of the service sector; and 64.9% of the industrial sector. They are dominant in terms of employment: 79.4% of the total of the workforce employed by the three sectors. Their participation in the GNP has been estimated to be near 40%. On the other hand, the participation of small and micro enterprises in public expenditures - a market of 100 billion dollars - corresponds to only 5%.

Participation of SMEs in different industrial sectors is shown in Table 1.

Table 1: Participation of micro-, small- and medium-sized enterprises in the different industrial sectors in Brazil.
Briquet de Lemos, A. A., Brasília, 1991

Sector	Participation (%)
Where the participation of micro-sized enterprises is above 85%	
Non-metallic mineral processing	90.75
Food products	89.51
Furniture	87.78
Wood	87.73
Publishing and printing	86.93
Where the joint participation of micro- and small-sized enterprises is above 85%	
Clothing, footwear and apparel	94.86
Cosmetics, soap and candles	94.47
Metallurgy	94.09
Beverages	94.01
Mining and quarrying	90.96
Rubber	90.87
Leather, hides and similar products	90.42
Mechanical products	88.49
Transportation equipment	88.44
Plastics	88.00
Where the joint participation of micro-, small- and medium-sized enterprises is above 85%	
Pharmaceutical and veterinary products	98.97
Paper and cardboard products	98.53
Chemicals	98.37
Textiles	97.69
Electronic and communications equipment	97.52
Tobacco	92.30

SMEs and access to information

The Serviço Brasileiro de Apoio às Micro e Pequenas Empresas (SEBRAE) maintains almost 400 branches (Balcões SEBRAE) all over the country. In these branches, which are located in different institutions, small entrepreneurs have access to different types of information:

Entrepreneurial information - how to register a firm, and its fiscal, labour and social security obligations. Legislation, including bills under discussion in the Congress.

Profiles of investment opportunities - location, market, technical processes, layout and economic and financial feasibility in the industrial, commercial, and services sector.

Profiles of indicators of municipalities - main features of the municipalities, including physical and demographic aspects as well as opportunities for investment.

Events - training courses, fairs, congresses, and other meetings in Brazil and other countries.

Entrepreneurial bibliographical database - bibliographical information oriented to the needs of entrepreneurs.

Directory of institutions - organizations related to the needs of enterprises, including information for direct mail.

Database to answer the requests from the productive sector - technical files and information sources.

ISO 9000 - international technical standards about quality in the areas of training and certification of personnel, self-diagnosis of enterprises and checking of instruments.

Directory of enterprises - includes name and location, size and number of employees.

Trade marks database - provides access to the trade marks database of the Instituto Nacional de Propriedade Industrial.

Analysis of foreign trade information - imported and exported goods: countries of origin and destination, enterprises, FOB value, quantity and average prices.

Technological Information Pilot System (TIPS) - commercial and technological opportunities among the participating countries.

Consumer Defence Code - updated information on the provisions of the consumers' code.

This information is made available through a computer network which is based on RENPAC.

The number of requests received by the branches is estimated to be around 160,000 per month. It is estimated that, if only 10% of these requests resulted in the establishment of an enterprise, then, theoretically, every month about 16,000 new firms were being created, with the creation of 570,000 jobs per year.

SEBRAE/IEI/UFRJ (1993), recognizing that one of the main prerequisites to increase competitiveness of SMEs is the availability of information to provide technical support to the managerial decisions, found that the majority of micro and small enterprises (between 82% and 72%) have information on those aspects most directly related to the day-to-day life of the enterprise, such as clients, competitors and suppliers. This percentage, however, is significantly lower when obtaining the information requires special effort, as happens with information about production and technologies. In the majority of cases, access to information is irregular and does not result from a permanent information collection activity.

> Contact with clients and other entrepreneurs (individually or at fairs and congresses) is the principal form employed by micro and small entrepreneurs to obtain information, while the utilization of specialized institutions (such as consultants, universities, etc.) is much less frequent, covering less than 20% of the surveyed entrepreneurs.

SMEs and the utilization of IT

There are indications that the degree of utilization of information technology is not commensurate with the economic and social importance of SMEs. This presumed underutilization of information technology may be an obstacle to their further development and a threat to their survival in a increasingly competitive situation.

Rousso (1992) called attention to the fact that the abuse of English words in information materials related to hardware and software is a serious obstacle to making the small entrepreneur familiar with information technology. One must bear in mind that the educational background of a large number (probably the majority) of small entrepreneurs is far from adequate.

A small entrepreneur has probably started his business because he acquired sufficient expertise in a process similar to the medieval system of apprenticeship. As he becomes master, he opens his business on the basis of the acquired experience. For him, the only choice is to reproduce this experience through the years.

In a country where the deficiencies of the formal education process are staggering, one should not feel surprise at a high rate of illiteracy among the manpower working in SMEs. A recent survey, sponsored by SEBRAE, found a proportion of 35% of qualified or university level staff, which "means that approximately two thirds of the workers lack a specific professional training". As expected, a higher proportion of qualified professionals is found only in those industrial sectors of greater technological content and in the

export-oriented firms.

Data on the utilization of IT by SMEs, collected in a nation-wide survey covering a sample of 70 enterprises, during the two last weeks of November 1993, with relevant comments, will be found at the end of this report.

SEBRAE/RJ and information technology

SEBRAE/RJ is the local SEBRAE for the state of Rio de Janeiro, whose capital is Rio de Janeiro. Of the whole SEBRAE network, it is the only one which maintains a program specifically designed to make micro and small enterprises more competitive and modern by means of the utilization of information technology. This program, know as INFO RIO, maintains the following projects:

- Seminars for entrepreneurs, with the aim of promoting the utilization of IT.

- Courses on IT planning, with the aim of training managers on how to identify the situations where computers are required.

- Training course for IT users, with the aim of preparing personnel of micro and small enterprises to develop their own software applications.

- Database of suppliers and products: an online service on suppliers of IT products and services.

- Fairs in the main cities of the state in order to exhibit and demonstrate the most recent IT products and services available in the market.

- Showroom: a permanent exhibition in Rio of hardware and software for micro and small enterprises.

- SOS Informatics: a toll-free consultation service, by fax or telephone.

- Software contests to identify and give an award to producers of the best software oriented to micro and small enterprises. The first award was won by a Brazilian software company for the management of micro and small enterprises. It is being sold at the price of US$ 70.

- Industrial and commercial automation.

- RIOSOFT (Software Export Centre): a project that aims at making Rio the main exporter of software in the country.

- Incubators: to support the creation of enterprises based on pioneer projects.

- Funding: to collect and disseminate information on funding available to micro and small enterprises.

The industrial and commercial automation project aims at the dissemination of inexpensive and simple solutions commensurate with the economic and technological situation of the micro and small enterprises, so that they have significant gains in terms of quality and productivity. It includes:

Identification and certification of available solutions. In the segment of machine-tool retrofitting, for example, 30 local manufacturers of kits have been identified.

Stimulus to the development of solutions with high economic impact. It covers the feasibility study of new retrofittings for other sectors, such as plastic injection machines.

Information Technology Program for Micro and Small Enterprises and Professionals (Pro-IMPE)

This program was launched this year. Its objectives are: the promotion of the local information technology market; the strengthening of software and services enterprises; the reduction of hardware and software smuggling and piracy; the guarantee that end-users will have access to better quality, lower prices and credit at reasonable cost and maturity date.

The program is based on a triple partnership. The federal government, through one of its funding agencies (FINEP), has provided US$ 1.2 million for the first year. ASSESPRO, the association of Brazilian enterprises of software and informatics services, is responsible for the administration of the program. A professional group or association acts as the sales outlet for each group.

The first sales were oriented to physicians, through a medical association of Rio de Janeiro. The second group were travel agents, through the Brazilian association of travel agencies in Rio de Janeiro, and also had the support of SEBRAE. Private schools will be the next group, followed by accountants.

The buyer can choose from among three to five options, each one with a complete configuration or kit. Each kit will include at least three different programs to be selected from a catalogue of Brazilian software provided by ASSESPRO, plus 20 hours of training and 20 hours of technical consultancy. The hardware is covered by a one-year maintenance contract. A basic option costs around US$ 4,000.

The program expects to reach 70,000 micro and small enterprises during a period of 30 months.

Other programs

Other programs where an IT component exists are:

- Programa de Apoio à Capacitaçäo Tecnológica da Indústria (PACTI), which aims at the implementation of activities leading to the development of innovative products and processes. One of the activities of this program is oriented to SMEs. Several institutions participate in this program.

- Linha de Apoio à Gestäo da Qualidade which aims at the implementation of quality management programs in national enterprises. FINEP provides loans to contract consultants to implement new methods to improve quality and productivity.

- Programa de Capacitaçäo e Treinamento de Recursos Humanos no Gerenciamento da Qualidade. It is being implemented by the Confederaçäo Nacional da Indústria. Its target population are the SMEs and its emphasis is on the training about techniques that will improve quality and productivity.

A survey on the use of IT in SMEs

With the collaboration of the SEBRAE national office in Brasília, a survey was carried out during the two last weeks of November 1993 and data was collected from 70 SMEs in 15 of the 26 states of Brazil. The sample covered a range of commercial (50.8%), service (33.3%) and industrial (27%) companies.

The number of employees in the sample varied from a minimum of one to a maximum of 358, with an average of 31.3. On the basis of the number of employees, 51.6% of the enterprises were small-sized, 37.1% were micro-sized, 8.1% were medium-sized, and there were two that were large-sized enterprises. The total sales in 1992 ranged from a minimum of US$ 1,066 to a maximum of US$ 3,001,636. Tables 2–7 show the results.

Table 2: Activities in Brazilian SMEs in which IT is used (52 respondents)
Briquet de Lemos, A., Brasília, 1993.

Activity	Number	%
Financial management	42	80.8
Word processing	38	73.1
Sales	35	67.3
Personnel management	32	61.5
Supply management	25	48.1
Telecommunication by fax/modem	24	46.2
Office automation	19	36.5
Productivity control	18	34.6
Quality control	13	25.0
Electronic data interchange	12	23.1
Library and information service	6	11.5
Access to external data bases	5	9.6
Electronic mail	4	7.7

Table 3: Areas in which the utilization of IT has resulted in benefits to Brazilian SMEs (46 respondents)
Briquet de Lemos, A., Brasília, 1993.

Area	Number	%
Management	32	69.6
Better product/service quality	25	54.4
Overall performance	23	50.0
Productivity increase	18	39.1
Reduction of production costs	16	34.8

Other areas that were mentioned:

- Increase in sales
- Preparation of texts, mail ordering, advertising and marketing
- Accounting
- Customer services
- Finances
- Security
- Collection of bills
- Stocks

TABLE 4: Areas of Brazilian SMEs in which IT might be more useful (59 respondents)
Briquet de Lemos, A., Brasília, 1993.

Area	Number	%
Personnel management	19	32.2
Stock control	15	25.4
Financial management	12	20.3
Sales	12	20.3
All areas	12	20.3
Finances	11	18.6
Accounting	10	17.0
Production control	7	11.9
Production cost control	5	8.5
Sales control	4	6.8
Management	4	6.8
Quality control	3	5.1
Mailing list	3	5.1
Office automation	1	1.7
Credit card management	1	1.7
Credit sales	1	1.7
Programming	1	1.7
Access to external databases	0	0
Industrial process automation	0	0
CAD-CAM	0	0
Telecommunication by fax/modem	0	0
Electronic mail	0	0
Electronic publishing	0	0
Electronic data interchange	0	0
Word processing	0	0
Staff training	0	0

Table 5: Major obstacles to a more intensive utilization of IT in Brazilian SMEs (63 respondents)
Briquet de Lemos, A., Brasília, 1993

Obstacle	Number	%
High price of hardware	47	74.6
High price of software	36	57.1
Unavailability of adequate software	24	38.1
Unavailability of qualified staff	23	36.5
Disbelief in IT effectiveness	2	3.2
Size of enterprise does not require the use of a computer	1	1.6

Other obstacles that were mentioned:

- Insufficient capital to invest in IT
- Optical character recognition
- Short time of implementation
- Insufficient financial resources
- Taxes
- Culture
- Internal problems
- Maintenance cost
- Unavailability or lack of knowledge about adequate software
- Non-existence of financing policies for hardware acquisition
- High interest rates

Table 6: Number of years of utilization of IT in 52 Brazilian SMEs
Briquet de Lemos, A., Brasília, 1993

Period	Number	%
> 6 months ≤ 1 year	10	19.2
> 1 year ≤ 2 years	6	11.5
> 2 years ≤ 3 years	15	28.9
> 3 years ≤ 5 years	9	17.3
> 5 years	12	23.1

Table 7: Suggestions for improving the utilization of IT in Brazilian SMEs
Briquet de Lemos, A., Brasília, 1993

Suggestion	Number	%
Personnel training	42	76.4
Software applications development	37	67.3
Information on the benefits of IT for productivity and quality	35	63.6
Financing programs for the acquisition of hardware	39	70.9
Reduction of hardware prices to international levels	35	63.6
Information on information services available through telecommunications	31	56.4

When asked how the reserved market policy contributed to the implementation of IT in their enterprises, most of the respondents (25 out of 53, i.e. 47.2%) answered that it had been irrelevant, whereas 16 (30.2%) said it had a positive effect, and 12 (22.6%) said that its role was negative. On the other hand, when asked whether the changes in this policy, introduced in 1992, would facilitate the adoption of IT, the number of affirmative answers increased to 62.9% (44 out of 70), and only four enterprises (5.7%) answered negatively, while 22 (31.4%) said that this was irrelevant.

Out of 51 respondents, only seven (13.7%) said that they had made use of government or private credits to acquire microcomputers. The utilization of a state bank special credit line (FINAME) was mentioned by only one of these seven enterprises.

The utilization of the information services provided by the 'balcões SEBRAE' was confirmed by 29 (43.3%) of 67 respondents and 38 (56.7%) said they had not used them. When asked about the reason for not using these services a range of answers was given, and most of them revealed that these services were not known.

Final considerations

The national informatics policy was essentially akin, in its industrial segment, to the industrialization policies which were first implemented in Brazil in the last century. If, in the early period of industrialization, the most conspicuous arguments in favour of the intervention of the state and the adoption of protectionist measures were the economic nationalism at the ideological level and the need to maintain (or to restore) the equilibrium of the balance of payments, in the case of the informatics industry other reasons were added. The strategic role of information technology, the need to keep pace with the technological advances which are inherent to modern industrial processes, and the search for economic competitiveness were some of these other reasons.

As in other areas of industrial development, the measures established by the national informatics policy effectively contributed to the construction of a diversified, horizontally structured, and dynamic IT industry. But, as also happened in other areas in previous times, the protection of local industry put a heavy burden on the consumer. The commentary by a historian about the industrialization process in the first three decades of this century is relevant to the present situation: "the consumers [...] carried the burden of an expensive industrialization process, buying costly and low-quality products" when the imported ones could be better and cheaper (Luz 1961).

The case of the IT industry involved a new dimension when compared with other industrial sectors, especially the complex processes required by the manufacture of the essential components of a computer and the speed of technological changes. During the period of the reserved market, the domestic industry was never able to overcome the technological gap between its products and those manufactured in the leading countries in this field. This gap was also present in all those products which had an informatics component.

The drastic changes that took place in 1992, when the reserved market policy ceased to exist, revealed some of the anachronisms and weaknesses of the national informatics policy and the frail bases on which some IT enterprises had been built. On the other hand, they showed that the country had been able to build an infrastructure of domestic production and services which will certainly contribute to reducing its technological dependence. These changes also brought forth an increased competitiveness which are leading to a reduction in prices and better products for the consumer.

The manpower development in the field of IT, especially at the industrial level, was one of the most important consequences of the Brazilian policy. It must be remembered that, until the 1970s, the domestic know-how was practically limited to the area of IT services with the support of foreign equipment. An enormous effort was required to train a broad range of specialists to work in the industrial sector, not to mention the area of research and development.

One of the weak points of the IT policy was its lack of concern with the end-user. It was not possible to democratize access to IT which remained, in general, a facility available to the administration, the state-owned companies, and large- and medium-sized private enterprises. As the figures shown above indicate, the home computer is still rare.

The introduction of IT in micro and small enterprises is a recent concern. Contrary to what advertising says, the utilization of IT technology is not just a question of plugging a PC into a wall-socket. Beyond the learning of the required skills, the potential computer user must change attitudes, overcome traditional practices, and acquire a new culture. Computer instruction in elementary schools, something that already exists in some countries, is almost nonexistent.

The survey that was made, although restricted to a very small sample of SMEs, indicates that the IT available in these enterprises is being mainly used in administrative routines. None of them, for example, replied that computers were being used in the automation of industrial processes or in CAD-CAM.

Suggestions for research

During the preparation of this report, it was possible to verify that there is a shortage of data and information about IT in SMEs in Brazil. The sheer number and diversification of SMEs, not to mention the dimensions of the country and the scattering of SMEs over the territory, will require an enormous effort to carry out a survey with some statistical relevance.

Suggested research projects could be categorized under the following lines:

obstacles to and incentives for the utilization of IT (hardware and software) in SMEs;

surveys of software available for SMEs;

training needs and the development of training packages for the introduction of IT in SMEs;

information needs and the repackaging of technical and managerial information for SMEs;

extension services for SMEs;

the utilization of CD-ROMs for the dissemination of technical information to SMEs;

cooperation between SMEs, universities, and other research institutions, with emphasis on problem-solving and the introduction of new technologies;

studies on networking for SMEs including electronic data interchange (EDI); and

regional markets (for example, Mercosur) and the exchange of information between SMEs.

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SEBRAE. 1991. Coordenação de Pesquisa e Desenvolvimento. As empresas de menor porte na economia nacional; alguns indicadores selecionados. 31 p.

SEBRAE-IEI/UFRJ. 1993. Indicadores de competitividade para micro e pequenas empresas industriais no Brasil (sumário executivo). 38 p.

Appendix

Some associations in the field of IT

Assespro Nacional (Associação das Empresas Brasileiras de Software e Serviços de Informática)
Avenida Treze de Maio, 33 - Bloco A - Sala 509
Rio de Janeiro, RJ
Telephone (021) 533-1185
Fax (021) 220-4706

Associação Brasileira de Automação Comercial
Avenida Paulista, 2644 - Conj. 102
São Paulo, SP 01310-300
Telephone: (011) 259-3444
Fax (011) 231-2808

Associação Brasileira das Empresas de Software (ABES)
Avenida Brigadeiro Faria Lima, 1857
São Paulo, SP
Telephone (011) 813-9511
Fax (011) 815-0359

Automática
Avenida Brigadeiro Faria Lima, 1541 - Conj. 9B e C
São Paulo, SP 01541-000
Telephone (011) 815-5302
Fax (011) 210-6890

Sociedade Brasileira de Interconexão e Sistemas Abertos (Brisa)
Rua Manuel Guedes, 504 - 4. andar
São Paulo, SP
Telephone (011) 829-5044
Fax (011) 820-2919

Comments of the working group

Research recommendations

Four research projects were proposed. The possibility of implementing these projects was analyzed, with the following results.

Project 1: determination of obstacles and incentives:

classical diagnosis by sector,

participation of students in the companies,

participation of retired managers, through an association of IT producers and users.

Project 2: subjects to be developed will be established as a result of Project 1.

Those considered included managerial awareness, specific training of middle managers, and the use of multimedia tools.

Project 3: promotion of links between SMEs.

The importance of the type of link that should be promoted was pointed out. (incubators, joint ventures, networking).

Project 4: access to information on information, information sources and methods.

Research context

The following elements were discussed in order to comply with the objective of promoting the SMEs.

Education: universities must prepare not only informatics professionals, but provide reality-based training, customized to the managerial field students are going to work in. Also, when training other professionals, adequate training in IT must be given. In general, all the population is expected to have access to the information culture.

Industrial policy: it must emphasize the role of IT and disseminate from the top down. The benefits of IT must be quantified, and the experiences of large enterprises must be translated, with the necessary adaptations, to the small ones.

Information: government and other institutions must provide action to collect and organize useful information for SME decision-making.

Supporting companies: this type of company must be developed, for instance in the financial field (fund raising), in the technical field (development, design, etc.), in marketing (outlook, production planning, business opportunities, etc.), in community services (solution to shared problems), etc.

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Issues for Policy Research

Norman Girvan, Consortium Graduate School of Social Sciences, Mona, Jamaica

Small open economies, small and medium enterprises, and information technology

Small open economies (SOEs) may be regarded as those with a population of under 5 million and a foreign trade ratio ((XGS+IGS)/GNP) of more than 0.5. In the developing world, SOEs are found mainly in the Caribbean, Central America and the South Pacific; with several others in South America and Africa. There is wide diversity in economic structures and levels of per-capita income among such economies. A common feature is their vulnerability to exogenous changes in the external economic environment. Most developing SOEs have highly skewed production/export production structures (predominance of one or a small number of primary commodities or services), and limited industrialization. They are, therefore, likely to be highly impacted by present moves towards the dismantling of preferential trading regimes and the establishment of an open, global trading environment. For them, the achievement of structural diversification with competitive efficiency is a strategic imperative.

Small and medium enterprises (SMEs) are defined for this study to mean those with up to 199 employees. These constitute the vast majority of enterprises in developing SOEs, and account for the bulk of employment and GDP generation. In the countries of the English-speaking Caribbean (Caribbean Community: Caricom) such enterprises are found in all sectors: agriculture, tourism, manufacturing, construction, repairs, trade, and other services. They range from self-employed artisans, to informal sector micro-enterprises, to standard formal sector firms employing scores of people. Hence, for example, the Caricom Secretariat estimates that small scale enterprises, variously defined:

account for about 45% of employment in member states;

account, in agriculture, for over 70% of the main export crops and an even higher proportion of domestic food crops;

play a leading role in the marketing of agricultural products;

generally provide the urban transportation for commuters and the ground transportation for tourists;

are leaders in manufacturing subsectors like wood products, garments and sewn goods, handicraft items; and

play a leading role in construction, equipment repairs and maintenance, technical service activities, and in the retail trade (ILO 1993, p. 1).

When medium-sized enterprises are included, it will be found that SMEs constitute virtually the entire economy outside of the large firms in sugar, bauxite, petroleum, distribution, and government organizations. Improving the efficiency and performance of these enterprises is necessary both on grounds of national competitiveness and of equity.

Information technology (IT) plays a growing role in the improvement of efficiency and the achievement of competitive advantage. A powerful characteristic of this technology (like electricity and steam power before it) is its pervasive character: it is, or can be, applied across virtually all sectors and products. "First mover" advantages are conferred on firms that adopt IT innovations in their processes or products; other firms face the necessity of following suit in order to stay in the competitive race. In industry after industry, computer-aided production and use of IT is defining the "standard" best-practice style of production (for example, flexible specialization), and incorporation of microelectronic devices is defining the standard products. The same is increasingly true of whole countries. Hence, country-wide competitiveness will be, at least in part, a function of the effectiveness of application and use made of IT.

So far there has been relatively little research on the use of IT for competitive advantage in developing countries, and for SMEs. This is true both at the firm level and at the national level (with the important exception of studies of Singapore), and applies as strongly to developing SOEs. A recent issue of the journal *World Development* (20,12; 12/1992) represents the first attempt known to this writer to assemble empirical material on the subject in a systematic way; but even here the paucity of case studies was notable, especially as regards SMEs.

The following is a suggested framework for the conduct of research on IT policy issues for developing SOEs, with special reference to the role of SMEs:

the macroeconomic policy environment;

the structure of production and its likely (or desired) evolution in the medium to long term;

general characteristics of the role of IT in enhancing efficiency and competitiveness at the firm, industry, and national levels;

potential role of IT in enhancing efficiency and competitiveness of SMEs, especially in "growth" industries and those likely to be exposed to international competition; and

policy instruments to support and facilitate the use of IT by SMEs, especially in the context of the point immediately above.

In this review paper we seek to illustrate how such a framework could be used by reference to the SOEs of Caricom states.

Macroeconomic factors affecting IT in SMEs

Macroeconomic policy environment

The process of structural adjustment, economic stabilization, and liberalization provides the context for IT policy issues in the SOEs of Caricom. In Table 1, the principal elements of the macroeconomic policies adopted under these programs are listed in the left-hand column, grouped under Fiscal, Monetary, Exchange Rate, Trade, Industry, and Investment Policies. In the right-hand column we identify the possible impact on IT investments, use, and accessibility; and on policy interventions actual and potential. The right-hand column therefore constitutes a list of possible research areas for the identification of IT policy issues which arise out of the impact of these macroeconomic policies.

Summarising the results of the Table, we find that IT investments and adoption are encouraged by policies of liberalization, deregulation, opening up of the economy, and export promotion. Growth of the banking and financial sectors and improvements in public sector financial and revenue administration are also likely to increase the demand for IT and the scope of application. Inimical to the spread of IT are credit restrictions; high interest rates; steep and frequent devaluations, which impact more heavily on SMEs than on large firms; import deregulation, which undermines domestic manufacturing industries; and financial constraints on governments' investment in IT-related training and R&D.

A preliminary hypothesis is that, on balance, structural-adjustment/liberalization policies encourage/facilitate IT adoption in large enterprises in banking, finance, public utilities, and government; but inhibit the spread of IT to SMEs. Evidence on the actual pattern of IT use in Jamaica, and Trinidad and Tobago, at the end of the 1980s is reviewed in the section on IT sources and applications in Caricom.

Structure and likely evolution of production

Table 2 below lists the major exports of Caricom countries and those slated for expansion, with an indication of the extent to which SMEs are involved in the industries concerned. Existing or new export industries where SMEs are important are: cane and bananas (small farmers), horticulture, hotels and other tourism ancillary industries, garments, information processing, food processing, and furniture. Research could be aimed at identifying the possible contribution of IT to efficiency and competitiveness in these industries. Some evidence on this is presented in the section on potential contribution of IT to SMEs in Caricom.

Table 1: IT implications of structural adjustment policies
Girvan, N., Mona, 1994

POLICY	POSSIBLE IT IMPLICATION
FISCAL POLICY	
Reduce budget deficit by public expenditure cuts	Reduced spending on training of IT professionals and technicians
	Reduced ability to support R & D and support services in IT, such as software development houses, computer repair and maintenance facilities
Reduce/eliminate consumer subsidies	Nil
Reduce/eliminate subsidies to state enterprises	Efficiency-inducing IT investments
	Reduced capital investment by SMEs impacting negatively on IT investment
Reduce direct taxes on corporate profits and personal incomes	Higher after-tax profits by corporations induce increased IT investment
	Regressive swing in personal income distribution increases spending on PCs by households
Introduce value-added taxes	Higher prices on IT hardware and software restrict ability of SMEs to acquire IT
Improve monitoring, accountability, and control over public expenditure	Increased use of IT in Government financial administration
Improve revenue and tax administration	Increased use of IT in Government revenue administration
MONETARY POLICY	
Credit restrictions	Restrict ability of SMEs to invest in IT
High interest rates	Restrict ability of SMEs to invest in IT
Financial deregulation	Expansion and heightened competition in banking and financial sector increases demand for IT

(continuec

Table 1 concluded

POLICY	POSSIBLE IT IMPLICATION
EXCHANGE RATE POLICY	
Devaluation	Higher prices of IT hardware and software in domestic currency restricts ability of SMEs to invest in IT
Floating rate	Uncertainty over prices in domestic currency reduces willingness of SMEs to invest in IT
Liberalization of exchange controls	Removal of bureaucratic impediments encourages investment in IT
TRADE POLICY	
Tariff reductions; elimination of quantitative restrictions	Easier access to and lowered prices of imports encourage investment in IT hardware and software
	Greater competitive pressure on local industries induces IT investments to improve ability to compete
	Dislocation of local industries reduces potential demand for IT
Export promotion	Growth of information-processing industry leads to increased demand for data-entry operators and for advanced telecommunication facilities
	Need for supporting information services leads to increased demand for IT services
INDUSTRIAL POLICY	
Price decontrol	Higher profits encourage IT investment
Industry deregulation	Heightened competition encourages investment in IT innovations
Fair competition legislation	Nil
INVESTMENT POLICY	
Privatization of state-owned enterprises	Greater autonomy and profitability of enterprises encourage IT investments
Removal of restrictions on/promotion of foreign investment	Foreign direct investment introduces IT innovations into the economy

Table 2: Principal exports of Caricom and the role of SMEs
Girvan, N., Mona, 1994

EXPORT	ROLE OF SMEs
Sugar	Small farmers are involved in cane growing
Bananas	Small farmers predominate in the OECS countries, large plantations in Jamaica
Horticulture	Numerous SMEs
Bauxite and alumina	(Large firms predominate)
Petroleum products	(Large firms predominate)
Tourism	Numerous SMEs in hotels and guest houses, restaurants, boutiques, crafts people and vendors, and rental car firms
Off-shore financial services	(Large firms predominate
Garments	Numerous SME operators
Information processing	Several medium-sized enterprises
Food processing	Numerous SMEs
Furniture	Numerous SMEs

Information technology, efficiency and competitive advantage: some observations

Firm level

Since the early 1980s there has been a rapidly growing literature on the use of IT to secure competitive advantage at the firm, industry, and national level. Firm-level applications have been analyzed with respect to internal operations and external relationships. Internal IT applications range from simple automation of data-processing functions (accounts, payroll, inventories, labour records), to computer-aided production (CAD, CAM, CNC tools, robots), and decision-support systems used by management. Their objective is to reduce costs, increase total factor productivity, and increase the firm's organizational flexibility and its responsiveness to the external environment.

Applications to external relationships relate to customers and suppliers. They include product innovation and differentiation in goods (eg consumer electronics) and customer services (eg ATMs, airline reservation systems). Supplier relationships are enhanced by "locking in" suppliers to the firm's production operations by EDI linkages. Useful summaries of the two kinds of applications are provided by Parsons (1983) and Bakos and Treacy (1986).

Industry level

The industry or sectoral perspective on IT use focuses on interfirm cooperation through Electronic Data Interchange (EDI), and the use of common information services. Firms which have achieved a certain level of internal computerisation and use information systems as a management tool, are linked up electronically to permit "just-in-time" production (for example, automobiles) and speedy response to sales trends in specific niche markets (such as garments). Hence, the gains from IT applications, both within and outside the firm, are more fully appropriated in terms of "systemic competitiveness" at the industry level, where the industry consists of one or more clusters of electronically linked firms. Commonly cited examples are the Japanese automobile industry and the Italian clothing industry.

National level

Success in national level IT use for global competitiveness rests on the emergence of IT-intensive industrial clusters as leading export industries within a country. Necessary conditions for this are adequate national IT infrastructure and appropriate government policies. Governments need to ensure the provision of an adequate infrastructure of electricity, telecommunications, and IT manpower to support cross-industry IT use. Government policies can also promote IT diffusion and assimilation amongst firms and industries, for example through subsidised credit and training. Governments can promote the IT industry directly by means of support for R&D in software engineering and (in more advanced countries) in chip design and manufacture and hardware architecture. Some writers (eg Perez and Lundvall 1985) argue that IT will define the framework of

international competition in the emerging global economy: that the relative economic position of countries will be a function of their relative success in utilizing the new technology.

IT and productivity

At the same time, a recurring theme in the literature is that investment in computerisation by firms often has little discernable effect on profitability and productivity. In the 1980s, the US banking industry made massive investments in IT: total spending on technology (mainly IT) moved from an annual rate of $4 billion in 1980 to $13.8 billion in 1990, but profitability declined in the late 1980s (Teixeira and Schmergel 1992, p.13). Crescenzi (1988, p.14) refers to a study of 30 strategic information systems adopted in Fortune 500 firms, which found that only five were successfully implemented. Ayers (1990, p.13) points to mounting disillusionment with computer-integrated manufacturing (CIM) in the U.S.

At the aggregate level, Mody and Dahlman (1992, p.1703) refer to studies of the industrialized countries which suggest that the productivity gains from computer use have so far been limited. They warn, however, that productivity measures fail to capture benefits such as product differentiation, market penetration, and improvement in customer service. In this connection, Herbert-Copley has pointed to the need for research into appropriate measures and methods of assessing the productivity impact of the introduction of IT.[1]

Implementation analysis

One response to such disappointments has been to analyze, by means of case study research, the conditions conducive to successful implementation of computerisation and utilization of IT by firms. Critical success factors which have been identified are:

careful advance planning to ensure that the system is aligned with the needs and strategic objectives of the firm;

strong commitment and involvement of the top executives of the firm to IT in general and to the particular system;

strong involvement of users within the firm in the design/selection of the system and in the implementation process – users, not the IT professionals, must "own" the system;

willingness to change work procedures, relationships, organization, and culture within the affected departments and the firm as a whole;

adequate staff training/retraining; and

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[1]Brent Herbert-Copley, in a comment on the first draft of this paper.

adequate financial resources (see Atkinson 1991, p. 55; Ayers 1990, p. 13; Crescenzi 1988, p. 14; Fried and Johnson 1992, Exhibit II., p. 2; King and Grover 1991, p. 296).

IT and organizational change

One result of the above observations is the growing recognition that organizational/cultural change within the firm is necessary in order to successfully implement a major IT project and to fully appropriate the gains from its use. Deschenes points to the growing importance of "method" in the implementation of IT-related technical change and technology transfer.[2] Most writers agree that responsibility and power must be decentralised, teamwork and initiative must be encouraged, middle management layers may be eliminated, organizational hierarchies will become flatter, relationships with suppliers will be restructured. All this encounters inertia and resistance within the firm. Such problems may prove to be more intractable than the technical issues of computerisation, especially if their importance is not fully recognized at the outset and strategies to handle them are absent.

Other writers go further, and argue that changes in the organization of production, rather than use of IT as such, is the fundamental element in the new forms of competition emerging in the world economy (Best 1990; Dahlman 1993; Piore and Sable 1984). Such changes are facilitated and reinforced by the high rate of progress in the processing power and range of applications of IT, giving rise to an interactive sequence of organizational innovation, IT innovation, further organizational innovation (eg Perez 1983; Freeman and Lundvall 1988). In this perspective, organizational innovations are seen as permitting the effective use of IT as part of a total competitive strategy. This contrasts with the more "technologically deterministic" perspective, in which IT innovations **per se** are seen as the basis of competitive advantage, leading to or determining the nature of the required organizational changes.

A stronger version of this line is the view that organizational change in line with principles of flexible specialization and "just-in-time" production, is actually a **prior** condition to successful automation (eg Mody et al 1992). This view is solidly based on detailed empirical studies of manufacturing industries in Japan and several other countries, but it is not certain that is applicable with equal force to service industries.

The lessons of the "implementation analysis" and the "organizational innovation" streams in the literature is to caution against seeing IT applications as a quick, reliable, or unique means of improving the competitiveness of firms and securing competitive advantage. There appears to be no alternative to detailed case study analysis at the firm and industry level of the obstacles to improved efficiency and the ingredients of better competitive performance. IT applications should be considered as one of several possible elements in a total approach to competitive production by firms and industries. We suggest that this is the perspective which should inform research on the potential contribution of IT to enhancing the competitiveness of SMEs.

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[2] Lucie Deschenes, in a comment on the first draft of this Report

IT sources and applications in Caricom: a review

Survey information on IT applications in Jamaica and Trinidad and Tobago, Caricom's two largest economies, have generated a number of findings which are relevant to this study (Deloitte & Touche 1993; Farrell 1993a and 1993b; Girvan and Marcelle 1993). These are summarised in this Section.

(1) While precise quantitative measures are lacking, there is a substantial degree of computerisation in the public and private sectors in both countries. This is especially the case among large organisations, but medium- and small-scale organisations also make some use of IT.

(2) The leading customer sectors reported by computer supply firms in both countries are banking; finance and insurance; and government (Ministries and Statutory Agencies). Other leading sectors of application in both countries are distribution (commerce), public utilities, government agencies, and heavy industry and petroleum (in Trinidad and Tobago). Manufacturing ranks only fifth in Jamaica, and tourism, the leading foreign exchange earner, ranks only seventh. In Trinidad and Tobago, manufacturing ranks third in sectoral application and, together with banking, finance, and services, is expected to be a major growth area of application in the future.

(3) In both countries, the leading application areas reported by supplying and using firms are accounting and office automation. Accounting applications are mainly general ledger, accounts payable, and accounts receivable, and are provided overwhelmingly by imported software packages. Applications to production operations are still relatively small. In Jamaica, computer supply firms ranked manufacturing-processing systems 11th in IT application areas, and productivity-enhancing systems for small businesses last out of 15 application areas listed. Similarly, a sample survey of using firms in 1992 ranked computer-controlled production eighth in order of application. However, it is notable that, in Trinidad and Tobago, CAD/CAM ranked second in software application areas. In both countries, use of integrated information/control systems or executive information systems in firms is as yet limited.

(4) In terms of hardware, stand-alone PCs and minicomputers are the main kinds of equipment in use. Of 26 large- and medium-sized firms representing the major sectors of the Jamaican economy surveyed in 1992, 57% used stand-alone PCs, while only 27% used networked PCs (PC-LANs), and 27% mainframes. Use of the more advanced systems was confined to the larger firms (500 employees and up) in the sample group.

In Trinidad and Tobago in 1993, 94% of large organisations surveyed (over 150 employees) were using minicomputer or mainframe configurations and only 6% were using PC-LANs. Medium-sized organizations (20-150 employees) were using primarily minicomputers (45%) and PC-LANs (31%). The majority of small

organisations (under 20 employees) were using stand-alone PCs.

Farrell's survey of MIS Managers in 53 organisations derived from the client lists of leading computer vendors, showed a predominance of minicomputers as a hardware platform. Of these organisations, 26% used mainframes as their platform, 55% used minicomputers, and 19% used PC-LANs only (Farrell 1993a, p.7). However, these organisations are likely to be those in the large- and medium-sized category.

(5) Commitment to the use of IT is still relatively weak and variable, even among large- and medium-sized firms. In Jamaica, just 50% of the sample-survey firms were found to have full CEO commitment to an IT strategy, 27% had CEO's support with reservations, and 23% of the CEOs were indifferent. Even more disturbing, 42% of the survey firms had no formal IT planning and a further 31% had no formal planning of any kind. Only 27% were found to have full integration of IT with the business-planning processes.

(6) With regard to IT implementation, 31% of the firms in the Jamaica sample survey entrusted IT responsibility to a single Chief Executive, 27% formed a permanent interdepartmental/affiliate project team, and 19% used ad hoc arrangements. Only one firm — the largest, with over 3,500 employees — constituted a special task force chaired by the CEO to implement IT as a special project. This was easily the most successful case of IT use turned up by the survey.

(7) In both countries, the main constraints on the diffusion of IT stem from the macroeconomic environment (devaluation, inflation, high cost of credit, foreign exchange scarcity) and from an inadequate supply of qualified IT manpower in using firms. Scepticism of the benefits of IT among senior managers, and difficulty in demonstrating such benefits, are also factors. Inadequacy and unreliability of the telecommunications infrastructure is another complaint in Jamaica.

(8) Structurally, the computer supply industry is dominated by large "full service" firms (hardware, software, systems consultancy) that are affiliated with major TNCs through ownership or technology agreements. The major players are IBM, ICL, NCR, and UNISYS. At the same time, a considerable number of small firms have been started by IT professionals, which obtain their hardware in East Asia and provide advisory and consultancy services to smaller users.

(9) Although sources of IT hardware and software is highly skewed towards the United States, the range of suppliers is quite wide. A total of 36 hardware and 46 software suppliers were identified for Jamaican computer supply firms; the Trinidad and Tobago survey identified 27 brands of hardware and 19 types of software. This could create problems for the repair and maintenance of hardware, and in the compatibility of software among firms.

(10) Commercial software writing is still in its infancy in both countries. Several instances of software adjustment and development for specific customer needs were found, including several specialised management information systems in Trinidad and Tobago. An incipient software writing ability therefore exists.

However, the export of software services is hindered by inadequate supply of programmers, absence of corporate strategies, inadequacy and cost of the telecommunications infrastructure, and absence of a supporting government policy.

In short, use of IT among SMEs in these countries is very limited, and likely to consist mainly of use of PCs for office word-processing, accounts and record-keeping. Even among larger enterprises, there is limited use of IT for strategic purposes such as product innovation/differentiation and winning new markets, let alone improving export competitiveness or creating new value-added services (not counting the special case of information-processing).

The main research questions here concern the extent to which the identified constraints on IT use in general apply specifically to SMEs:

costs of equipment in an inflationary, high interest-rate environment;

lack of qualified manpower;

uncertainty or ignorance about the pay-offs to investment in IT;

organizational/cultural barriers, and

other factors.

However, it is important to bear in mind that other factors affect the access of SMEs to technology in general and affect their competitive performance ability. The most important of these are availability of and access to:

skilled management,

finance,

technical information,

markets and market information, and

the competitive environment.

These other factors need to be taken into account in the conduct of research on, and in addressing IT policies for, SMEs. The research framework should be multidimensional, examining the totality of the contextual factors affecting the conduct and performance of SMEs. A unidimensional research frame which identifies IT issues alone is likely to produce misleading results, since policy measures which focus on IT use in isolation from other variables affecting performance are unlikely to be effective.

Potential contribution of IT to SMEs in Caricom: some evidence

The potential contribution of information technology to promoting the growth of SMEs in Caricom countries, and to enhancing their efficiency and competitiveness, may be considered in three areas:

access to, and use of, computerised information systems;

use of electronic data interchange (EDI); and

intracompany computerisation.

Below we review some of the evidence in these areas, gathered from interviews and documentary material collected in the course of this study.

Information systems

It is generally agreed that access to vital information is one of the critical constraints on the performance of SMEs (Neelameghan 1993). Crucial information needs relate to:

- **technology:** process techniques, equipment availability and costs, packaging, technological alternatives;

- **inputs:** availability, costs, quality;

- **market conditions:** existing and prospective demand, factors affecting demand trends, competitive environment; and

- **regulatory environment.**[3]

In principle, provision of computerised information services to these enterprises offers the possibility of decentralised, speedy access to a wide variety of information available from local, regional and international services. In practice, several conditions need to be met for this to be effective. Systems need to be adequately equipped and staffed, with adequate and stable funding. Their design should take into account the low level of computer literacy and the technophobia prevalent amongst small business persons.

For instance a system providing decentralised terminal access may need to provide an information intermediary at each terminal, who interprets the information needs of the clients and uses the system on their behalf. Provision of dial-up facilities, will require the user to have a PC and to have some training in the use of the system. This might be more suitable for established small and medium (rather than micro) enterprises, and for more

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[3] Adapted from Neelameghan 1993, p. 4

specialised, sector-specific knowledge.

All these are questions for detailed research. Some of the issues are evident in reviewing current facilities in Jamaica and Trinidad and Tobago, and the case of the Caribbean Trade Information System (CARTIS), reviewed in the section on use of IT for trade information in SMEs.

Jamaica

Jamaica's Scientific Research Council (SRC) is the principal government agency involved in the provision of general scientific and technical information to SMEs. The SRC's Information and Coordination Services Division houses a Documentation Centre with 13,750 documents covering several subject areas including food and nutrition, agro-industry, biotechnology, and chemical engineering; with special collections on Trade, Appropriate Technology, and Science Policy. Documents are available on reference only. The automated bibliographic database has 3,300 entries. Some 940 requests from various sectors were handled in the period January-November 1993.[4]

This Division has been designated as the focal point for two projects involving computerised information systems. The first is the National Scientific and Technical Information Network (STIN). This is the main project involving computerised information, and aims to provide users with ready access to scientific and technological information available in Jamaica (Bardowell 1993, p. 3). STIN was formally established in 1979, and is said to consist of "almost fifty decentralized, autonomous information units in the public and private sectors" (Bardowell 1993), with sub-systems in agriculture; science, technology and the environment; conservation; health; mining and energy; and physical planning. On-line access to international databases, including DIALOG and CUNET, is also available.

The second project is the Caribbean Energy Information System (CEIS). This aims to share information in New and Renewable Sources of Energy (NRSE), energy conservation, and petroleum. CEIS utilises national Focal Points in each of 12 Caricom member states, with on-line access to energy databases in the Regional Secretariat (Bardowell 1993 pp.3-4).

This study did not turn up any evaluations of STIN or CEIS. However, one evident problem is inadequacy and instability of Government funding. Hence, in 1993, only 37% of STIN units had computers and "some" were developing computerised bibliographic and numeric databases (Bardowell 1993, p.4). Also, the SRC's Information Division was reporting severe resource constraints: loss of five strategic top positions, operating on only 43% of staff complement, lack of equipment for information handling (such as computers, modems, and scanners), and lack of an explicit budget (Bardowell 1993, p.5)

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[4] Information supplied by the SRC

Trinidad and Tobago

The Government-funded Caribbean Industrial Research Institute (CARIRI) undertakes R&D and provides a variety of technical services to industry. CARIRI is the largest institute of its kind in Caricom; with a 1991 budget of TT$13.5 M (US$3.1 M); and a staff of 139 including 44 professionals and 53 technical and technical support staff (CARIRI 1991). CARIRI's Centre for Technology Sourcing and Intelligence (CTSI) provides services ranging from "simple Query and Answer services to detailed techno-economic studies, patent searches, technological profiles, in-plant technical consultancies, equipment evaluation, technology sourcing and evaluation and joint venture assistance" (Bardowell 1993 p. 6). The CTSI is supported by a professional and staff complement of 14, a documentation centre with 22,000 holdings, and computerised on-line access to international databases (Bardowell 1993, p. 6). However, no evaluation of the CTSI's effectiveness to users is available.

The Government's Small Business Development Company (SBDC) provides highly simplified technical information in documentary form on products/processes suitable for very small enterprises.[5] SBDC is planning a decentralized computerised information system with terminal access for users at various locations throughout the country, but this is not yet operational. SBDC also claimed that a referral system to CARIRI was available to its clients, but interviews with CARIRI staff suggest that this was not in operation.

Information systems within and outside the region

There are several examples of the use of IT to effect regional cooperation for the sharing of technical and other information. One such is the Caribbean Energy Information System (CEIS), referred to above. The ECLAC Office for the Caribbean in Trinidad has developed a major economic and social information system for the countries in the Caribbean Development and Cooperation Committee (CDCC), which includes the Spanish-, French-, and Dutch-speaking Caribbean. The Caribbean Tourist Organisation (CTO), which also includes the non English-speaking countries, has developed a large database on Caribbean tourism for use by its member organisations. The Caribbean Export Development Project (CEDP) has implemented the Caribbean Trade Information System (CARITIS) to provide members with up-to-date trade information, both from within the region and outside. These experiences need to be properly assessed to derive lessons on the use of information systems for SMEs.

Another possible area of application of IT is in the sharing of the results of R&D carried out by public sector research institutes (eg Jamaica's SRC, Trinidad and Tobago's CARIRI, Guyana's IAST, the Produce Chemistry Laboratories in the OECS, etc). These relate primarily to the use of indigenous natural materials in agro-industry and mineral-based industries. It was suggested (Girvan et al 1993) that sharing of results would help reduce duplication, facilitate cooperation and specialisation, give producers access to a wider range of information, and facilitate trade and investment within the region.

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[5] Interview with Mr Haven Allahar, CEO of SBDC, October 13, 1993

As regards databases/communication outside the region, the Internet stands out as a global network of low-cost data communication whose utility to SMEs needs to be explored.[6]

Another example comes from a proposed UNIDO Project for Jamaica, which recommends the establishment of Resource and Technology Centres for the apparel, furniture, and capital goods (repair and maintenance) subsectors. Each centre would link into relevant international centres of technical information on product design and processes, and develop a data bank for use by producers. There are several research issues which arise in this area:

breadth versus depth of coverage of information systems;

format of delivery and dissemination of information to users;

technical issues: appropriate software and hardware configuration (in function of the two issues above);

value and cost-effectiveness of regional cooperation; and

lessons to be learnt from actual cases.

Many of these issues are illustrated in the experience of CARTIS, discussed in the section below on use of IT for trade information in SMEs.

Electronic Data Interchange (EDI)

Market intelligence and marketing

Export development programs in food products, garments, and furniture emphasise "niche" marketing and differentiated products. This requires continuous, up-to-date market intelligence on market trends and sales opportunities. EDI, which links distributors abroad with export promotion agencies in Caricom countries and through them to producers, is a possibility here. This would facilitate external market access by SMEs who are too small to establish their own linkages with external distributors, or their own EDI systems. EDI could be on a regional basis, eg for fresh food exported to the Caribbean "ethnic" market abroad, where one supplier may be unable to fill an order.

In the Jamaican furniture industry, it has been proposed that EDI could link producers to interior designers and architects in the U.S. South (Best 1991). Orders with requirements and designs could be fed in real time to producers in Jamaica, facilitating a quick response and thereby improving their competitiveness.

Small hotels and guest houses in the Caribbean would benefit from access to or participation in a computerised international reservations network linked to airlines, travel

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[6] Suggested by Daniel Pimienta in a comment on the first draft of this Report

agents, and the national tourist agencies. At present, these systems are accessible mainly to the large hotel chains. Such a system would widen the market to SMEs in this sector, allow better capacity utilization, and widen the accessibility of visitors to the range of visitor accommodation, heightening the attractiveness of Caribbean destinations.

Interfirm cooperation

This is likely to be of particular value where it is proposed to reorganise an industry along the lines of flexible specialization, with close cooperation amongst independent firms in the production of parts and components and the supply of different market niches. Such a model has been proposed for the Jamaican furniture industry (Best 1991). In this context, the linking of firms through EDI would allow real-time exchange of information on orders, raw material shipments, stocks and inventories, and movement of finished products.

Intracompany computerisation

Management and decision-support systems

Diagnostic studies of the food-processing and furniture industries in Caricom countries reveal that record keeping, production monitoring and production scheduling are major areas of weakness (Best 1991; Hopley 1991). This gives rise to low capacity utilization, low productivity, high production costs, and uneven product quality. These may be addressed by simple computerisation using stand-alone PCs and appropriate software. Tracking orders and accounts receivable is another obvious application. Simple computerisation of production flows may also be a first stage towards EDI among firms.

An example of the scope for such intracompany computerisation is provided by a small Cypriot clothing firm which reorganized its production around the principles of flexible specialization. The owner/manager

> established a joint venture with a Cypriot software writer which developed a computerised integrated database containing the detailed characteristics of all orders, their cut details and delivery data. It automatically provided a bill of materials, helping to reduce raw material and final product stocks, it provided more accurate orders to raw material suppliers abroad, and up-to-date detail on which items were selling well. It also helped production scheduling, allowing control of the scheduling to pass to production staff thus freeing senior management (Murray 1990, p. 10).

There is need for research on "modular" systems suitable for use by enterprises of say, 10-100 employees. It is observed that computer-supply firms are oriented to the high end of the market, and operate on the assumption that "more is better", where "more" equals greater processing power, memory, and speed. Simpler models of less versatile equipment may be all that a particular SME needs. Little work appears to be done on customizing the standard accounting and database software packages for the special needs of small businesses. Development of a "modular" system using simple PC hardware with built-in software for use as a management-support tool by SMEs, supported by an

appropriate training system, may be one way to facilitate IT use by these enterprises.

CAD

UNIDO-sponsored studies of the furniture and garments subsectors in Jamaica recommended the use of computer-aided design (CAD) as an important tool for raising product quality and the ability to compete on external markets (Best 1991). Cost and means of making such systems available to SMEs would need to be investigated.

Use of IT for trade information for SMEs: the case of CARTIS

Background

CARTIS was an ambitious attempt to apply up-to-date IT for a regional trade information system servicing the needs of trade promotion agencies and the business community, including SMEs. CARTIS is generally acknowledged to have failed to meet many of its objectives. As such, it offers instructive lessons on the issues involved in using IT for these purposes, and on regional cooperation in this area.[7]

Features of CARTIS

CARTIS was launched in 1988 as a project of the Caricom Secretariat, to develop an information infrastructure incorporating a network of trade information centres in the 13 member states of Caricom. Funding of US$870,000 was provided by UNDP. By 1989 the decision had been taken to move the project to Barbados and to integrate it fully into the Regional Trade Development Program (RTDP) of the Caricom Export Development Project (CEDP), whose objective is to develop trade within and outside the region. In summary, the main features of CARTIS were to comprise:

> **national nodes** or centres to collect and input data into a computerised system, sharing it on a network consisting of trade-related institutions in the public and private sectors, and providing information services to users, including SMEs, through a number of access nodes for information retrieval;
>
> linking of the national centres to a coordinating **Regional Centre** in Barbados, with responsibility: (a) to ensure the collection of information relevant to the needs of the users and its accessibility to network members in a timely fashion and in suitable formats; as well as (b) for training, systems design and development;

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[7] The information on CARTIS is drawn entirely from Chapter Two of the Jones Report on CEDP (Jones 1993). CARTIS was beset by problems from the outset; the Jones Report begins by noting that "Since its inception in 1988 (CARTIS) has had its experiences extensively documented in a series of in-house evaluation reports and a number of studies carried out by consultants" (p.47).

linking of the Regional Centre to external sources of data and information: overseas trade missions of Caricom states, regional and international trade information systems, and service and trade institutions; and

on-line access at information retrieval nodes to stored data as well as to external databases, complemented by diskette service to national centres for regular information updating, and publication of directories and newsletters, etc.

Information categories to be covered were:

- company/product profiles,
- statistics,
- trade opportunities and notices,
- trade services institutions,
- barriers other than tariffs,
- buyers/distributors,
- sources of industrial inputs,
- standards,
- import procedures, and
- bibliographic data.

Hence, the project envisaged that a user would be able to visit an access node and have a world of trade information at her fingertips: national, regional, and international. SMEs were among the principal target beneficiaries, and one program element was a project for Small- and Medium-Scale Enterprise Marketing Advisory Services.

Problems encountered with CARTIS

As early as 1989, it became evident that CARTIS was not functioning as expected, and by 1992 UNDP had decided to cease funding the project. Among the main sources of difficulty identified were:

information provided was too broadly spread over the entire regional market and too diffuse, need for targeting of selected sectors and products consistent with an export development strategy;

the wide range in the availability of usable data among member states made standardisation and harmonisation of data inputs much more difficult and costly than originally anticipated;

inadequate promotion of CARTIS services in member states, due to inadequate funding and also to lack of confidence among national centres in the ability of the system to service demands;

weaknesses in the national centres: inadequate clerical, professional and financial support to national centres; high staff turnover and failure to transfer training; unsuitability of some local facilities provided; failure of some governments to meet their commitments to national centres; overloading of data accumulation capacity

due to the need to duplicate software and data-bases at all focal points; all leading to slow and patchy provision of information, not always carefully matched to needs of clients; and

weaknesses in the regional centre: erratic cash flow; inadequacy and lack of continuity of professional and clerical staff; diversion of staff time to preparation of project-revision documents and attendance at regional conferences.

System modifications

While some initial hitches and learning costs are unavoidable in any project of this kind, many of the above problems were evidently due to faulty design and poor planning. The project was redesigned in 1991-1992 into an "Enhanced System" with the following changes.

In place of national centres, a network of information providers called Information Centres (ICs) would be established, the criterion of membership being ability to deliver quality information on time. These would include qualified business-development organisations, research institutions, financial institutions, overseas consulates and trade missions, statistics departments, etc.. Each IC would have its own client base.

One of the ICs, Barbados External Telecommunications (BET), would host the regional databases, proving access to a sophisticated database system. BET would also operate the Trade Opportunities and Enquiry/Reply Services.

The Regional Centre would continue with essentially the same responsibilities but would be enabled to concentrate on monitoring and upgrading of the system as well as provision of selected information services.

Coverage would be expanded to include agricultural marketing information.

A pilot project to test the enhanced CARTIS would be carried out in late 1992, using a prototype database based on a sample of countries and products and addressing the three principal needs identified by clients: (a) company profiles, (b) trade control measures, (c) trade statistics. Also promoted in the pilot project would be the "Trade Match by Fax" service, and the Business Opportunities Bulletin.

As of March 1993, the pilot project was only partially completed. CARTIS was working on a three-year business plan, aimed at securing financial viability by promoting income-earning services and phasing out those functions without a commercial potential.

Lessons of CARTIS

Jones (1993, p. 74) observed that "(...) the short life of CARTIS has been one process of remedial action to a basically good yet flawed concept that had no real chance of success in terms of its stated objectives."

The fundamental flaw was to attempt to apply a general and unfocused trade information service to a group of nations with widely different trade environments and priorities, differing levels of expertise and institutions, differing levels of data availability and differing degrees of commitment to and understanding of the role of trade information. In terms of research-policy issues, we suggest the following preliminary conclusions:

Systems design should start with the perceived needs of the SMEs as the point of departure, and derive its features from these needs and circumstances, as well as the absorptive capabilities of these institutions.

Where a network of information collectors/providers is envisaged, careful evaluation of the capabilities and commitment of network members should be undertaken. The project should include provision for remedying any resource deficiencies in manpower, etc., as well as a process for winning and maintaining the commitment of the members.

A focal point, whether national or regional, should seek to build on the strengths and capabilities of network members: it cannot substitute for them. Hence, a system ought not to begin with a focal point or given set of information services to be provided, and then seek to incorporate network members and then users. Rather it should flow out of the needs of users and the capabilities of members, and seek to adapt existing information services to these.

In the technical characteristics of system design, there is a trade-off between volume/range of data and cost. Hence, careful evaluation of the quality of input data and its relevance to actual needs will be necessary in order to ensure cost-effectiveness.

Finally, a detailed examination of the CARTIS case may provide useful in-depth lessons as a "cautionary tale" on the design and implementation of information systems to service the needs of SMEs. Such an examination could begin with the copious documentation and evaluation material which exists on the system.

Information technology policies in Caricom

General nature of IT policies

Explicit IT policies can cover a number of areas. A useful way of mapping or preparing such policies might be in terms of:

- objectives,
- functional areas, and
- specific policy instruments.

Table 3 illustrates.

Table 3: Mapping IT policies
Girvan, N., Mona, 1993

OBJECTIVES

Diffusion of IT
Development of the domestic software industry
Development of the domestic hardware and components industry
Development of the information services industry.

FUNCTIONAL AREAS

Human resource development (education and training)
Telecommunications
Research and development
Investment promotion

INSTRUMENTS AND MEASURES

Public expenditure
Public investment
Public subsidies
Fiscal incentives
Credit policies
Legislation
Standards
Foreign investment policy
Import policies
Government procurement and computerisation policies

Instruments and measures can be cross-referenced to functional areas and objectives according to which functional area(s) the instrument addresses and which objective(s) it is designed to serve. Ideally, it would be possible to construct a policy matrix in which functional areas, instruments and measures are arranged as the rows, and objectives as the columns. Hence, the means by which a particular functional area (for example, training in computer literacy), relates to a given objective (such as IT diffusion) would be identified; and specific policy instruments (for example, public expenditure) related to that. A country with a comprehensive IT policy framework would be able to fill all the cells in the matrix.

Comprehensiveness notwithstanding, the most important requirements of an effective IT policy appear to be strategy and coherence. Strategy involves the formulation of specific objectives for the role of IT and the development of the IT sector over the

medium term in the broader national context. Coherence requires that the key elements necessary for the accomplishment of objectives be set in place, and be consistent with one another as well as with the rest of the policy environment.

The case of Singapore

The Singapore case is especially instructive on the importance of articulating strategic objectives and adopting coherent policies in pursuit of them (Wong, 1992). In 1990, Singapore was ranked first in the world by the **World Competitiveness Report** in the extent to which IT is effectively used (Wong 1992, p. 1817). In indicators of IT usage (telephone and telex density, computers per capita, IT expenditure/GDP, number of information workers/labour force), Singapore leads the developing countries and is on par with the developed world (Kuo 1990, Ko Kheng Hwa 1990). In 1987, 59% of organizations with 10 or more employees already used computer systems (Ko Kheng Hwa, p. 17).

The Singapore achievement is a direct consequence of a national IT program launched in 1980, as part of a strategic shift of the economy from labour-intensive industrialization to knowledge-intensive and high value-added activities. Key elements of the IT program were:

establishment of a National Computer Board to spearhead and coordinate the program,

huge investments in the telecommunications infrastructure and establishment of an Integrated Services Digital Network (ISDN),

large-scale training of software professionals,

promotion of foreign investment in the software and information services industry,

the civil service computerisation program,

promotion of IT use by industry through sectoral policies, and

promotion of an IT culture in the society as a whole (Wong 1992).

Of special interest is the program to promote IT use among small- and medium-sized businesses in Singapore. For example, through the Requirements Assistance Program (RAS), the NCB contacts SMEs (less than SGD 8 million in fixed assets) and offers them technical advice and assistance in installing or upgrading a computer system. Firms have the option of enroling in the Small Enterprise Computerisation Program (SECP), which provides continuous guidance on their computerisation process at every step along the way (Gable and Raman, 1992).

The specific elements and mechanisms of the strategy used in Singapore respond to that country's own unique circumstances. The lessons for other developing countries lie

less in the specifics, and more in method and approach.

IT Policies in Caricom

The present study assessed the current status of IT policies at the regional and national levels in Caricom. The main sources used were relevant policy documents, supplemented by interviews conducted with senior officials and educators in the latter part of 1993. Most of the material relates to Caricom (regional), Jamaica, Trinidad and Tobago, and Barbados.

It emerged that no generalised IT strategy or comprehensive policy for IT in the sense discussed in the two sections above has yet been developed in Caricom. This applies both at the regional level and among the leading member states. However, several areas relating to IT are being addressed, though in a somewhat fragmented manner. These are mainly:

telecommunications,

information processing,

education and training,

software development, and

microelectronics repair and maintenance.

Below we summarise the general situation with respect to S&T and IT policies as it obtains in Caricom and the countries reviewed. Policy developments are furthest advanced in the areas of telecommunications, information processing/services, and human resource development; and these are discussed in the sections below on selected IT policy issues.

Caricom

Caricom's proposed S&T Policy and Plan lists 12 priority areas for regional action and cooperation. Those relating to IT are:

a regional electronics repair and maintenance facility;

cooperation in telecommunications technology;

microelectronics, specifically the pooling of resources in software development to achieve economies of scale; and

training in basic computer literacy, particularly among state officials, as a means of consciousness-raising among officials.

The proposals are short on concrete measures and implementation mechanisms.

With the possible exception of the establishment of the Caribbean Telecommunications Union (CTU), no regional cooperation along the recommended lines is known to have taken place. It is also notable that regional cooperation in S&T is not mentioned in any of the national S&T policy documents, nor by any of the interviews conducted with officials, in Jamaica, Trinidad and Tobago, and Barbados.

Jamaica

In 1990, the Government of Jamaica published a National Science and Technology Policy (Jamaica 1990a). The draft document had been prepared by the board of the Scientific Research Council (SRC) and discussed at a national seminar with representatives of the public and private sectors and the S&T community. The revised document was again circulated widely to interest groups and other members of the interested public, Members of Parliament, etc., before publication under the signature of the Prime Minister. In its 29 printed pages, the National S&T Policy makes only indirect reference to IT in a short paragraph on microelectronics (4.9). This refers in a general way to support for manufacturing/production activities, software development and provision of maintenance facilities.

Shortly thereafter, Jamaica also adopted a Five Year Development Plan for 1990-1995 (Jamaica 1990b). This singled out S&T as one of the "Global Issues"; the S&T chapter was subsequently revised and published as a separate document (Jamaica 1991). The revised document is probably the most comprehensive and coherent statement of needs and proposed measures for the S&T sector published so far. Like the National S&T Policy, it resulted from a wide range of consultation with the private sector and the S&T community. Current and on-going research in S&T is listed, priority sectors for S&T action are identified, detailed steps outlined on a year-by-year basis. and a public sector S&T budget for 5 years is provided. However, even the indirect reference to IT (microelectronics) present in the National Policy did not find its way into the S&T Plan. It should be noted that information processing was treated in the Development Plan in the chapter on Tradeable Services; and telecommunications was treated in the chapter on Communications.

Subsequent to this, lobbying by the Jamaica Computer Society and representatives of the information services industry resulted in the establishment of an IT policy committee by the Government's Adviser on S&T. The focus of concern of the committee was the promotion of computer literacy and the training of IS professionals. Unfortunately, after a few meetings, the committee languished for lack of resources and support.[8]

The Government-sponsored Scientific Research Council (SRC) does not have an IT division or a program related to IT.[9] A project for the establishment of a National Maintenance and Electronics Laboratory at the SRC was not brought to completion. The

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[8] Interview with Dr Arnaldo Ventura, GOJ S&T Adviser, October 25, 1993

[9] Interview with Dr G. Van Taylor, Executive Director, SRC, October 26, 1993

National Commission on Science and Technology, established in 1993 as an activity under the National Policy and Plan, has not so far considered IT in its deliberations, although the issue of telecommunications policy has been discussed.

A notable instance of the failure to assign IT a strategic role in S&T policy is provided by the results of the UNDP/GOJ Project for Endogenous Capacity Building through Multiple Stakeholders Dialogue (Henry 1993). No aspect of IT is reflected in the final portfolio of initiatives developed through this project. Representatives of the computer industry and the information processing sector made a late attempt to have a computerisation policy incorporated into the Project Report, to no avail (Winton 1993).

In spite of the above, this writer is convinced that there are good prospects for putting IT on the national policy agenda. The public debate on telecommunications policy and the proposed licence to the national telecommunications carrier, TOJ, provided dramatic illustration of this (see the section below on selected IT policy issues).

Trinidad and Tobago

Trinidad and Tobago is currently in the process of preparing a national policy on S&T (Pantin et al 1993). An Interim Strategy was submitted by the Prime Minister to the Cabinet in 1992, to be followed by a Task Force for the preparation of the Draft National Policy. The Interim Strategy is concerned mainly with institutional rationalisation and reorganisation of the S&T and R&D activities of the public sector, including the state-owned enterprises and the University. Whilst IT is mentioned as one of the areas of R&D for which CARIRI (the Government-sponsored Caribbean Industrial Research Institute) should cooperate with the University's Faculties of Natural Science and Engineering, no specific thrust or direction is provided.

The Government's senior S&T body is the National Institute for Higher Education, Science and Technology (NIHERST). NIHERST is charged with promoting and sponsoring R&D for national development, advising Government on S&T policy, and undertaking tertiary education outside of the University (NIHERST 1985, para. 1.7). NIHERST's IT-related activities have focused on microelectronics, and on computer education. Surveys of microelectronics use were carried out, and efforts were made to organise a coordinated approach to the development of a microelectronics capability through collaboration with the UWI and CARIRI. Unfortunately, the microelectronics unit was closed in the late 1980s due to staff turnover. As of 1993, a Microelectronics and Informatics Committee had been established which plans to review available information on microelectronics application and utilization in Trinidad and Tobago.

With respect to computer education, NIHERST sponsors training of IT technicians and professionals at its Information Technology College (see the section below on select policy issues).

It was reported that an Information Technology Task Force chaired by Professor Ken Julien of the UWI's Faculty of Engineering had drafted a report for consideration by

the Cabinet.[10] The Report appears to be concerned mainly with policy issues related to access to the telecommunications infrastructure and services. The Government's Medium Term Planning Framework devotes detailed attention of telecommunications, as the critical basis of the role that information technology is to play in national development (Trinidad and Tobago 1989, p.245).

Barbados

Barbados does not have a formal S&T policy or plan. However, an Informatics Committee was established by the Government in July 1993, to act in a policy advisory role to Government on telecommunications and the information services industry. Further details on this Committee are provided in the section on selected IT policy issues.

Other observations

Three other observations should be briefly mentioned. First, both in Jamaica and in Trinidad and Tobago, the view is widely expressed that development of a software export industry as an option should be promoted. So far, however, no government initiatives have been taken to encourage such a development (for example, accelerated training, special facilities, incentives.)

The other observation is that, in both countries, computer professionals as a group are beginning to exert pressure for the active use of IT and computerisation in national development. The Jamaica Computer Society, with a membership of over 400, has been promoting the establishment of computer labs in every secondary school, with private sector support. It has also embarked on a program for the training of school teachers in computer science. In Trinidad and Tobago, an association of MIS professionals is being formed, with support from the Central Bank. The potential role of computer professionals as agents of change and IT modernisation needs to be taken into account in policy formulation and implementation.

Conclusions: research issues

Policy measures for IT as a whole in the Caricom region are being taken in an ad hoc, fragmented, uncoordinated, and incoherent manner. As a result, several areas where support for the adoption of IT in SMEs could be promoted are not being pursued. Examples of these are through development financial institutions, such as the Caribbean Development Bank (CDB), and several national development banks which exist in Caricom. Small industry/enterprises support agencies (such as Trinidad and Tobago's Small Enterprises Development Co., SBDC, and Jamaica's Micro Enterprises Development Co., MIDA) provide another potential institutional mechanism for the promotion of IT use which

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[10] Interview with Dr. M. Manchuk, Director of NIHERST; and Dr. B. Narine, Head of Research, Port-of-Spain, November 1, 1993

is not being tapped because of the absence of a generalised approach.[11] These are concrete examples of policy areas not now being addressed, which need investigation.

Apart from other specific elements of IT policy (including telecommunications, human resource development, and information services, which are reviewed in the sections below on policy issues), some research issues which relate to the need for a total approach are:

commitment of top public and private sector leaders for an active policy for the use of IT as a tool of national development, including the development of a shared vision and consensus;

institutional options for the leadership, implementation, and management of the national IT strategy;

critical sectors and functional areas of policy that are appropriate for the given strategy;

mechanisms and policy instruments that will be the most effective to accomplish the objectives derived from the strategy; and

feedback, monitoring, evaluation and modification mechanisms.

Selected IT policy issues: telecommunications

Issues

Policy issues with respect to telecommunications are assuming great importance in the region. The issues concern:

ownership and foreign investment;

investment in technological modernization (digital transmission, optic fibres, cellular service, telecommunications);

monopoly versus competition in the provision of value-added services;

access to the infrastructure by third parties and rates, ie "connectivity" issues;

rates for international data transmission to the information processing industry; and

the role of regional cooperation.

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[11] The potential role of financial institutions and small business development agencies were both mentioned in comments on the first draft of this Report

The issues are current in three leading Caricom countries: Jamaica, Trinidad and Tobago, and Barbados. These are reviewed in turn below.

Jamaica: the TOJ Issue

In late 1993, a public controversy emerged in Jamaica regarding the content of proposed telecommunications legislation and the terms of a proposed telecommunications licence to the firm Telecommunications of Jamaica (TOJ), an affiliate of the British TNC, Cable & Wireless (C&W). The controversy illustrated many of the current issues involved in telecommunications policy in the region.

Background to the TOJ issue

Prior to 1987, Jamaica's external telecommunications service was provided by Jamaica International Telecommunications Lt. (Jamintel), owned 51% by the Government of Jamaica (GOJ) and 49% by C&W. Telephone service was provided by the government-owned Jamaica Telephone Co. (JTC). In that year, Jamintel and JTC were merged to form TOJ, a joint venture between GOJ (82%) and C&W (9%). At the time, the government declared its intention to divest its shares to the Jamaican public, in line with its stated privatisation policy. However, over the next three years, it divested the majority of its shares to C&W so that, by 1990, the latter owned 79% of TOJ's equity (with the public holding the remainder). Through TOJ, C&W now had an effective monopoly on Jamaica's telephone and external telecommunications business.

As part of the joint venture agreement, TOJ acquired fresh licences for telephone, external telecommunications, telegraph, telex/teleprinter, and wireless-telephony services (Jamaica 1988a, 1998b, 1988c, 1988d, 1988e). These licences replaced the previous ones held by JTC and Jamintel. They were valid for 25 years from 1988, with options to renew for a further 25. However the legal situation was untidy. The telephone licence was issued under the old Telephone Act of 1893, which covered only a wire-based service. The other four licences were issued under the old Radio and Telegraph Control Act, which covers radio and telegraph facilities. In 1990, TOJ secured a commitment from the GOJ that new legislation specifically covering telecommunications would be enacted, and a new telecommunications licence issued (Manley 1990a).

The Draft 1993 Act and Licence

The proposed new Act and Licence were drafted by lawyers representing TOJ/C&W (Jamaica 1993a, 1993b), and by mid-1993 began to be the subject of discussions with GOJ officials. The principal features which were to become contentious were those which would give TOJ exclusive rights over all forms of voice, data and video (except radio and domestic TV) communications within Jamaica and with the rest of the world for the next 50 years.[12] It appears that the draft Act and Licence received the support of the

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[12] Specifically, this would cover "Voice telephony (...) Including, without limitation, cellular radio, mobile radio telephone, videophone and voice telephony associated with cable systems (...) All forms of data transmission services regardless of the transmission media

Ministers of Legal Affairs and of Public Utilities (responsible for telecommunications).[13]

However by the time the matter came up for consideration by the Jamaican Cabinet, several senior GOJ technocrats were vigorously opposing the TOJ/C&W proposals. Both documents were circulated within a widening group of interested members of the public and media. Their terms began to be widely debated on radio and in newspapers and TV; with participation from representatives of TOJ, the information services community, academia (including the present writer at a public forum, Girvan 1993), and ultimately the Minister of Public Utilities.

A full listing of the features of the actual and proposed arrangements with TOJ to which objections were raised would include:

the length of the licences;

the guaranteed rate of return on revalued assets (17.5% to 20%);

the absence of efficiency incentives;

the absence of protection of consumers with respect to rates and quality of service;

the monopoly on telecommunications service within Jamaica and with the rest of the world; this would include all voice and data traffic regardless of the means of transmission, and all satellite telecommunications services;

the absence of regulation of connectivity services;

the monopoly on the provision of telecommunications equipment; and

the failure to establish a regulatory authority in advance of new legislation and the granting of new licences.[14]

Apart from the intrinsic merits or demerits of the TOJ/C&W proposals, there was also the hotly debated question whether the 1988 licences, and the 1990 commitment given the company, actually covered, or was meant by the GOJ to cover, all the exclusive rights that the company was now claiming in the draft Act and Licence (Manley 1990b).

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including, without limitation, telex, facsimile, electronic mail and packet switching and data transmission associated with cable systems and any other form of telecommunications services which are switched services as defined herein" (Schedule I of Draft Licence).

[13] See "The breakthrough - by letter", in ***The Sunday Gleaner***, July 12, 1993; with copies of letters from TOJ's lawyers to the Minister of Legal Affairs dated July 8, 1993; and from the Minister of Legal Affairs to the Minister of Industry, Tourism and Commerce, dated July 9, 1993 (Coone 1993; Patterson 1993).

[14] See Spiller and Sampson (1993).

Of particular concern to representatives of the fledgling information-services industry were the absence of regulation, monopoly, and the failure to establish regulatory authority (Hicks 1993). TOJ's monopoly on external data and video communication would give them a privileged position in the export of data services and in pricing services to firms seeking to export such services. One firm claimed to have lost a contract which could have generated 1,000 jobs because TOJ's rates are internationally uncompetitive (Robinson 1993, p. 2). Electronic networking among firms within Jamaica, and between firms in Jamaica and overseas, would also be hindered by the failure to provide for connectivity to the internal TOJ infrastructure at low or reasonable cost, and by the external telecommunications monopoly. The implications of technological convergence — a telephone cable is likely to become an "information highway" for the conduit of multiple services and provide access for multi-purpose equipment — are that the TOJ monopoly would be extended to these areas. To sum up:

> Recognizing that the economy of the world is becoming more and more dependent on efficient and low-cost telecommunication, to give one company such a monopoly, and for so long, is tantamount to surrendering Jamaica's ability to compete globally in the future and to deny the Jamaican people access to the variety of services that are going to depend on low cost telecommunications facilities (Robinson 1993, p. 2).

At the time of writing (December 1993), the proposed Act and Licence are being reviewed by a special inter-ministerial committee chaired by the Prime Minister, supported by a technical committee chaired by the Cabinet Secretary (Thompson 1993).

Lessons

The TOJ affair is a dramatic expression of the growing impact of the revolution in information technology on public policy issues in the SOEs of the Caribbean. Its most telling lesson is the need to have a comprehensive IT policy framework within which to fit policy issues relating to the telecommunications infrastructure. The crucial mistake made by GOJ officials was to think of telephones and telecommunications as being synonymous, that is thinking in terms of previous technologies. Because telecommunications is the carrier of IT, and IT is a service industry in its own right as well as impacting on all sectors of the economy, telecommunications now has to be considered in a much wider light.

A second lesson is the need to have adequate technical capabilities within the public sector, or available to it, in policy-making and decision-taking on IT and telecommunications matters. A third lesson is the changing balance of political forces in public policy-making resulting from the IT revolution itself: in the TOJ affair a major part has been played by young professionals who have entered, or are seeking to enter, the information-services industry.

Trinidad and Tobago

Among Caricom countries, Trinidad and Tobago has the most comprehensive and detailed policy statement on the role of telecommunications in national development. According to the Government's **Medium Term Planning Framework, 1989-1995,**

"Telecommunications development in Trinidad and Tobago will provide the infrastructure for economic and social-cultural transformation, as well as enhance this country's internal, regional and international communication linkages." (para. 28.7). The main elements of the five-year policy and program set out for telecommunications are:

> merger of the state-owned telephone (Telco) and telecommunications (Textel) enterprises to enhance the management and cost effectiveness of the industry, with Cable and Wireless as a major (though still minority) shareholder;
>
> investigation of the feasibility of using cellular radio for the provision of telephones to rural areas and of a marine cellular system within Caricom;
>
> upgrading of the public telecommunications system to provide the following services: enhanced tele-marketing services, Caribbean paging, satellite services, enhanced video-conferencing, enhanced database access, enhanced maritime services, a service to provide cellular phones in boats, INMARSAT services, phones in aircraft, videotext, distance teaching, and Caribbean television;
>
> for the mobile communication system, upgrading of infrastructure, systems development and the training of technicians; in particular upgrading of the maritime facility at North Post Trinidad to implement the Global Maritime Distress and Safety System adopted by the IMO and the ITU;
>
> in satellite communication, continued monitoring of developments, particularly the study of the feasibility of a Caribbean satellite system; and
>
> establishment by legislation of a Telecommunications Authority with responsibility for policy formulation for telecommunications development, licencing and management of the frequency spectrum, establishment of policy guidelines for broadcasting, and monitoring development of technology and advising accordingly.[15]

By late 1993, the same issues which had become current in Jamaica were exercising the attention of the Government of Trinidad and Tobago. A Government Task Force on Information Technology Policy was examining questions such as the scope of the exclusive telecommunications franchise, and accessibility and connectivity to the telecommunications infrastructure. These developments underline the need for stronger regional cooperation in this field.

Barbados

So far as can be gathered, the Government of Barbados has no formal statement of information technology policy. However, in 1993, a National Advisory Informatics Committee (NAIC) was set up within the context of the national objective of ensuring that

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[15] Radio and television are also dealt with (Trinidad and Tobago 1989, pp.246–252).

Barbados effectively competes in the information-services industry.[16]

The NAIC arose out of a call by several information-service companies for a reduction in the "lease circuit" rates of Barbados External Telecommunications Ltd (BET) to internationally competitive levels. Problems arose in attempting to negotiate a solution with Bartel and the Minister of Trade decided to establish the NAIC as an ongoing consultative and advisory body.

The NAIC is chaired by the CEO of BET/Bartel (Barbados Telephone Ltd). It has 12 members drawn from the UWI, the Barbados Investment and Development Bank, the Telecommunications Division of the Ministry of Trade, the Central Bank of Barbados, and the information-services industry. Its principal responsibility is with the development of the information-services industry by:

monitoring domestic and international developments,

assessing the telecommunications infrastructure needs of the industry,

assessing its manpower needs,

identifying required changes in the legislative/regulatory environment, and

promoting awareness and more active use of IT by local businesses and organizations.

As of November 1993, the Committee's action plan included (a) holding of a series of informatics workshops, (b) development of a model showing the impact of different variables on the performance of the information-services industry, (c) development of a strategy to improve business use of IT, and (d) identification and promotion of a high impact IT project which would bring local and overseas investors quick benefits.

Barbados is therefore the only one of the three countries surveyed that has identified the promotion of IT use by firms as a specific objective. Like Jamaica and Trinidad and Tobago, the issue of telecommunications rates to the information-services industry is now a major one for policy-makers, underlining the needs for regional cooperation in this area.

Regional cooperation

The Caribbean Telecommunications Union: role and structure

The Caribbean Telecommunications Union (CTU) represents the first stage of an attempt at functional cooperation in telecommunications within Caricom. Formed in 1990,

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[16] Interview with Mr. C. Niles, Deputy Permanent Secretary, Barbados Ministry of Trade, Industry and Commerce; November 19, 1993

the CTU is an umbrella organization of the policy-making divisions or agencies responsible for telecommunications in government ministries within the Community.[17]

The initial impetus for the CTU came from the need for a coordinated Caricom position on representation and discussions in international fora. The International Telecommunications Union (ITU), at its general meeting in 1992, recognised the Caribbean as a specific group in Region 2. Following this, the CTU coordinated the election of a Caribbean representative to the ITU's Administrative Council, and the ITU posted a representative in the region. Membership in the ITU provides access to participation in training programs for technicians and policy-makers at the level of Permanent Secretaries and Ministers. The CTU also hopes to access funding for its member states to enable greater attendance at international meetings, which is costly.

The CTU also proposes to promote technical cooperation in telecommunications among Caricom states. This would include training for lawyers in telecommunications legislation and licencing, advice on model telecommunications legislation, establishment of a Caricom telecommunications network to assist the needs of those members not adequately serviced, and advice on the most efficient routing of telecommunications traffic. The organizational structure of the CTU consists of:

the **General Conference**, comprising the Ministers responsible for telecommunications in the various member states, meeting every two years;

the **Executive Council**, comprising permanent secretaries/or chief technical officers responsible for telecommunications in the responsible ministries;

the **Secretariat**, headed by the Chief Technical Officer assisted by a technical engineer; this is responsible for the implementation of the work plan and is located in Port-Of-Spain, Trinidad; and

the **Technical Conference**, to discuss technical problems as they come up (for instance, the issue of telecommunications interference from Venezuela); this meets every two years and its composition varies according to the subject under discussion.

Assessment

So far the CTU has had little if any impact on telecommunications policy at the national level within Caricom. In none of the three states reviewed was the CTU mentioned by policy-makers as having an input into the major policy issues which are currently the subject of intense discussion. The CTU is not referred to in any of the official policy documents which were consulted for this review. Within the Secretariat, there is a perception that the organization has low political support from member states and the responsible ministers. The Caricom Secretariat, which is responsible for organizing

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[17] Interview with Mr. John Norbert, Telecommunications Engineer, Caribbean Telecommunications Union.

international funding for the CTU's Secretariat and Work Plan, is believed to be concerned about the limited effectiveness of the organization so far.

Our review suggests that there is an a priori need for regional cooperation in (a) coordinating and harmonising the approach to telecommunications legislation and licencing in a number of critical areas, and (b) coordinating policy on the issues of rate-setting for telecommunications services used by the information-services industry. This is underlined by the fact that each government is negotiating essentially with the same telecommunications firm, C&W. In addition, technical cooperation has the potential of enhancing the capabilities of Caricom countries to monitor developments in this rapidly changing field and to set policy. The CTU has the basic structure through which such cooperation can be realized but, for this to be accomplished, governments need to recognize the limitations of individual action and the potential benefits from regional cooperation to a much greater degree than at present.

Select policy issues: human resource development and information services

Human Resource Development

Overview

HRD for IT can be considered in various categories, corresponding to the different levels of skills required. These are:

Basic Skills

basic computer literacy,
data entry,
use of applications software,
hardware repair and maintenance,

Advanced Skills

programming, software development/engineering,
systems engineering,
hardware engineering, R&D, and
hardware manufacture.

Basic skills are normally provided (a) in the primary and secondary school system, (b) in specialised training institutions, and (c) through in-service training. Advanced skills are provided by tertiary institutions and by large IT firms.

As far as SMEs are concerned, their internal skill requirements would normally be for the basic skills of computer literacy, data entry, and use of applications software. They also need adequate and appropriate support from hardware and software firms and repair and maintenance facilities. These require personnel with advanced skills.

Addressing the HRD needs of SMEs, therefore, will involve a combination of (a) development of basic user skills tailored to their internal needs, by means of in-service training programs and staff participation in short courses; and (b) development of (mainly) advanced support skills in service firms, mostly provided by tertiary institutions and specialised repair and maintenance training schools.

Human resource endowments and scarcities: evidence

No comprehensive inventory of human IT resources in Caricom exists. Some information is available from surveys conducted in Jamaica (Girvan and Marcelle 1993) and Trinidad and Tobago (Farrell 1993b). This is summarised in Tables 4, 5, and 6.

Table 4: Employment profile of 25 Jamaican computer-supply firms, 1991
Girvan, N., Mona, 1993

Category of employee	Percent
Professional/managerial	7
Professional/technical	67
Other	26

N = 911
Source: Girvan and Marcelle 1993, p. 55

Table 5: Education of MIS professionals in Trinidad and Tobago, 1992
Girvan, N., Mona, 1993

Education	Percent
Computer Science, postgraduate degree	11
Computer Science, first degree	37
Other degree	20
Diploma, other	32

N = 177
Source: Farrell 1993b, pp. 3–4

Table 6: Job titles of MIS professionals in Trinidad and Tobago, 1992
Girvan, N., Mona, 1993

Job title	Percent
MIS management staff	10
Systems Analyst	14
Systems Engineer	12
Database Administrator	12
Other technical support	12
Not specified	40

N = 194
Source: Farrell 1993b, pp. 3–4

These data provide a kind of a partial "first cut" of the IT skill profile in the two countries, but they are not sufficiently refined to indicate the precise nature of the skills available, especially where SMEs are concerned.

As regards scarcities, some evidence can be found in the surveys of supplying and using firms undertaken in Jamaica and Trinidad and Tobago (Girvan and Marcelle 1993). In Jamaica, inadequate numbers of high quality IT personnel in using firms was ranked fourth as a demand constraint by firms in the computer supply industry (Girvan and Marcelle 1993, p.107). The same firms also ranked unavailability of technical skills fourth among constraints on their own ability to expand (Girvan and Marcelle 1993). Among using firms surveyed, unavailability of skilled labour and lack of computer literate staff was ranked second, after the cost of IT, as a constraint on IT application (Girvan and Marcelle 1993, p.135). In Trinidad and Tobago, computer illiteracy in using firms was the leading constraint on the growth of computer use listed by computer supply firms, while human resource deficiencies was ranked second as an internal constraint (Girvan and Marcelle 1993, pp. 229–230).

Human resource deficiencies are probably most acute at the level of advanced skills. The Planning Institute of Jamaica (PIOJ) estimates that skill needs are reasonably well catered for in the lower-end base-level categories, while the greatest need is for software development and engineering personnel with training in computer science and management information systems (PIOJ 1993, pp. 31–32). Total supply of IT personnel should be approximately 40% greater, concentrating in these high-level activities. In Trinidad and Tobago, training interventions have also been directed at higher-level skills.

Presently, there is no comprehensive program for HRD in IT in Caricom countries. Several training programs are being undertaken, some of a general kind and others in response to specific needs. This may be illustrated by reference to the situation in Jamaica and Trinidad and Tobago.

Jamaica

While a few preparatory schools (ie privately operated pre-secondary schools) offer computer-literacy courses, there is no general computer literacy program at the primary school level. At the secondary level, some schools now prepare students for the Cambridge GCE Ordinary Level Computer Science Examination. The Caribbean Examinations Council (CXC) planned to introduce Computer Science at the 1993 Examination. The number of students taking the Cambridge Computer Science Examination has been increasing but the failure rate is high. Teaching resources suffer from both qualitative and quantitative inadequacies: the Planning Institute of Jamaica reported that, of over 500 graduates of five selected teacher training colleges in 1990/91, only one student included Computer Science as an option during this period (PIOJ 1993, p. 30). Also, few schools have adequately equipped computer laboratories.

In 1991, the Jamaica Computer Society Education Foundation launched a project to address these problems and to promote the spread of computer literacy. The project aims to establish a computer laboratory in every secondary and technical school, teacher's college and community college by 1996. Its cost is shared between the private sector (60%) and the Government (40%), and is administered by the Human Employment and Resource Training Program (H.E.A.R.T), a government agency. By 1993, over 200 computers had been installed under the project, but use of the hardware was being constrained by shortages of competent teachers. This is to be remedied by the conduct of teaching workshops in the long summer vacation. The project is a good example of leadership by IT professionals and public-private sector collaboration in the promotion of basic computer literacy, which should have spin-offs for SME capabilities.

Also at the level of basic skills, the H.E.A.R.T. Program provides training in data-entry skills. Several private firms offer courses in computer appreciation, applications software (word-processing, spreadsheet, database), coding in popular languages, data entry and systems analysis. There is no standardisation, regulation, or certification of these organisations.

Tertiary training in Computer Science is provided by the College of Arts, Science and Technology (CAST) and the University of the West Indies. Interviews with firms in the IT sector suggest that there are both quantitative and qualitative inadequacies at this level (Girvan and Marcelle 1993, pp.84–85; PIOJ 1993 pp. 30–31). Apart from insufficient numbers, using firms complain that graduates lack practical "hands-on" experience with applications, and unfamiliarity with state-of-the-art equipment and technical developments. Other areas of deficiency are skilled software engineers and programmers capable of producing export-quality material, and telecommunications expertise.

A significant initiative is the new Master's degree in Management Information Systems and Computer Science, being launched jointly by the Departments of Management Studies and Computer Science at the University of the West Indies. The degree is aimed at graduates and mid-career professionals from management and computer science backgrounds. Its objective is to equip students with the ability to integrate understanding of the latest advances in the two fields in order to utilise computer-based

systems to create competitive advantage at the firm level.

Trinidad and Tobago

The National Institute for Higher Education, Science and Technology (NIHERST) has been the prime mover of IT training at different levels in Trinidad and Tobago. From 1983 NIHERST initiated computer studies in secondary schools; this was supported by the introduction of teacher training in the forms of the Computer Science for Teachers Diploma and Certificate programs as part-time (evening) courses. NIHERST is the coordinating institution for the new CXC Computer Science Program and Syllabus, and now orients teacher training towards the CXC exam.[18]

NIHERST began tertiary level training in IT in 1984, and formally established its Information Technology College (ITC) in 1987. The ITC offered a Higher National Diploma (HND) in Computer Studies, a program with a large practical component aimed at equipping students to contribute to an industrial working environment with a minimum of in-house training. In 1992 it was decided to replace the HND with the Associate Degree in Computer Science. The Associate Degree keeps the strong practical component of the HND but adds courses from psychology, management, and foreign languages to bring about a more rounded and general education. It is a terminal degree but can also be used to secure exemption from the first year of the UWI degree in Computer Science, and it is offered on a part-time and full-time basis. Hence the Associate Degree offers more options, while filling the needs of industry for IT technicians with a practical orientation.[19]

Conclusions: HRD research issues for IT

Research issues in this subject area will be a function of the defined IT needs of SMEs. Surveys can be conducted to identify the internal skill requirements of these firms, as they perceive them. The limitation is that many managers will be unaware of the scope for profitable use of IT, so that "felt needs" for training may underestimate potential needs. Diagnostic studies of the scope for IT application, and resultant HR and training needs, could supplement surveys.

Another kind of training need arises out of the requirement for software and information systems oriented to the specific circumstances of SMEs. Hence, training in computer science and management information systems would need to pay particular attention to the conditions and needs of SMEs, which might otherwise be neglected because they exert a small influence on the market.

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[18] Information provided in interviews with Mr. I Furlonge, Director, NIHERST ITC, 21 October 1993

[19] Furlonge Interview; also Annual Reports of NIHERST for 1985, 1988; and NIHERST ITC, n.d.

Information Services

Policy issues with respect to information services are closely tied to issues related to the telecommunications infrastructure. One report estimates that a world market of US$ 100 billion/year will soon be accessible to offshore information-processing centres. The new export services are made possible by advances in telecommunications, computer processing power, and collaborative software. They include the following services: transcription/secretarial, voice-centred operations, image processing, technical writing/abstracting/indexing, CAD and GIS, electronic publishing, software development, and multimedia database creation.

It is claimed that Caribbean locations are well-positioned to exploit these markets, with potential employment effects running into the tens of thousands and foreign exchange earnings of hundreds of millions. The main requirements for the development of the industry are said to be:

Adequate telecommunications infrastructure at competitive rates: in Jamaica and Barbados, uncompetitive rates have been a major complaint of information-service companies. One solution is the establishment of a Digiport (free zone for information processing serviced by a satellite link). This was done in Jamaica, but the facility is available only to companies which locate in the Digiport and TOJ has opposed proposals to give access to the Digiport's facilities to other exporters of information services.

Incentives: this would include relief from income taxes, customs duties, and foreign exchange control; and rapid business registration procedures.

Training: data-entry operators, software professionals, and other skilled labour in the industry.

Financing: for example in Jamaica the industry's representatives requested US$10-15 million in development funding at concessional interest rates of 10-12%.

Issues of policy research suggested by this review

1. The impact of the macroeconomic policy variables associated with programs of structural adjustment, economic liberalization, and privatization on encouraging/facilitating or discouraging/hindering the use and diffusion of information technology (IT) among SMEs in different sectors of the economy.

2. Sector-specific studies of the potential contribution of IT to the achievement of international competitiveness among SMEs; paying attention to the role of

   information systems catering to the needs of SMEs,

   electronic data interchange (EDI) among SMEs, and

   intracompany computerisation within SMEs.

   Tourism, food processing, furniture, and garments are examples of sectors in which such studies might be carried out.

3. **Productivity measures and research methods** for assessing the impact of the use of IT on the competitive performance of SMEs.

4. With respect to **information systems**, the issues of:

   breadth versus depth of coverage of information systems;

   format of delivery and dissemination of information to users;

   technical issues: **appropriate software and hardware configurations** (in function of the two issues above);

   value and cost-effectiveness of **regional cooperation**; and

   possible value of **international data communication systems** such as the Internet.

5. **Case studies** of actual experiences of information systems set up to assist SMEs, such as STIN (Jamaica); the ECLAC Caribbean system; and CARTIS (Caricom); will be of value to explore the issues at 4 above.

6. With respect to EDI, the feasibility of using this for interfirm cooperation and for linkages with external customers.

7. With respect to intracompany computerisation, the feasibility of **modular systems** or **"model" systems**, for low-cost computerisation of records for production monitoring and scheduling, financial analysis, and sales.

8. The importance of **organizational change** as a precondition to, or necessary condition of, the effective use of IT in contributing to international competitiveness in specific sectors and industries.

9. The extent to which identified constraints on IT adoption among firms in the Caribbean apply specifically to SMEs:

   costs of equipment in an inflationary, high-interest rate environment;

   lack of **qualified manpower**;

   uncertainty or ignorance about the pay-offs to investment in IT, and

   other factors.

   Such research should take into account the totality of factors affecting the access of SMEs to technology in general and their competitive performance ability.

10. The use of **CAD** to raise product quality and industry competitiveness in the furniture and garment subsectors.

11. With respect to the formulation of **comprehensive national IT policies**:

   factors involved in securing the **commitment of top public and private sector leaders** to an active policy for the use of IT as a tool of national development, including the development of a shared vision and consensus;

   the **institutional options** for the leadership, implementation, and management of the national IT strategy;

   the **critical sectors and functional areas** of policy that are appropriate for the given strategy;

   what **mechanisms and policy instruments** will be the most effective to accomplish the objectives derived from the strategy; and

   feedback, monitoring, evaluation and modification mechanisms.

12. With respect to **telecommunications**, the following policy issues:

   comparative policies on **ownership and foreign investment**, and their effectiveness;

   policies regarding investment in **technological modernization** (digital transmission, optic fibres, cellular service, telecommunications);

   regulatory policy issues regarding (a) monopoly versus competition in the provision of value added services, (b) access to the infrastructure by third

parties and rates, (connectivity issues); and (c) rates for international data transmission to the information-processing industry; and

the role of regional cooperation.

13. With respect to human resource development, the relative importance, organisation, and content of strategies to address the internal skill requirements of SMEs for basic skills, that is:

basic computer literacy,

data entry, and

use of applications software;

compared with strategies to address the skill requirements of support services, which are of a more advanced nature; comprising:

hardware repair and maintenance,

programming and software development/engineering,

systems engineering, and

hardware engineering.

14. With respect to other factors, case studies of the role of development financing institutions and small business development agencies, in promoting the diffusion and adoption of IT among SMEs, to derive lessons on the appropriate institutional forms, and measures to effect this objective.

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Comments of the working group

Research recommendations

Subjects of policy research may include:

economic issues:	macro and micro levels;
sectoral issues:	hardware, software, telecommunications, and others;
organizational:	management, training, reengineering, etc.;
technological:	access, use, dissemination of IT; transfer mechanisms;
information:	networks; EDI;
sectoral and technological:	incentives for research and development; innovation.

In relation to the summary of issues for policy research proposed at the end of the paper, it was commented that:

Point 1 is very broad and not a priority;

Point 2 is an important one for the analysis of the impact of IT on enterprises. The study should focus on:

productivity-competitiveness,

transition to open economies, and

country-differentiated impact.

Points 3 and 6 can be integrated to point 2, but 6 is the most important.

Point 7-9 are policy issues. What should be identified is HOW, to identify the content that will overcome the constraints.

There are two additional problems:

the supply of information systems in the region, and

the individual problem of each enterprise to update its information systems or decide what equipment to buy.

A recommendation is made to think more in terms of direct sectoral policies rather than in macroeconomic terms.

Strengthen the link: user-services-systems-information. Identify linking mechanisms.

Assess the applicability of some Latin American models in Central American and Caribbean countries.

It is important to study the competitiveness-productivity factors and correlate them with IT:

diagnosis,
awareness (promotion and transformation),
access,
training (equipment and information management),
participation (decision-making process), and
mechanisms of technology transfer.

Research methods

Research must be conducted bearing in mind that the implementation of recommendations should not take too much time.

Research context

Very little research has been conducted on SMEs, the examples studied belong to large enterprises.

More development is necessary on the subject of IT in relation to competitiveness. The cost of hardware is relatively larger for SMEs. Important work needs to be undertaken in the future to promote the use of IT by these enterprises.

It has been observed that the work conducted in the Caribbean countries is fragmented.

Improvement could be obtained in five fields: financing, market, organization, labour, and technology. Network tools should be used now. In the future, electronic highways could be incorporated.

Need for Sectorial Services Centres:

accessible to the small entrepreneur who does not have the equipment,
training for the entrepreneur who does have it,
offer "know how" information, and
benefit from economies of scale in the services rendered.

The issue of financing should be approached from the dissemination of the already-available financing systems and their corresponding mechanisms of access, rather than from the standpoint of its increase.

Definition

The definition of SMEs must be more precise, especially when deciding on promotional loans.

ACRONYMS AND ABBREVIATIONS

?ABBES	(Brazil) (09:04)
?ACAL	(06:02)
?CIPEMI	(journal) (04:02)
?CRESALC	(06:05)
?IEI	(Brazil) (10:13)
?INSOTEC	(Ecuador) (11:01)
?INTIB	(04:03)
?ISER	(Caribbean) (13:51)
?UFRJ	(Brazil) (10:13)
ABC	(Brazilian Association of Computing)
ABEP	(Brazilian Association of Data-Processing Enterprises)
ACDE	Asociacion Cristiana de Dirigentes de Empresa (Uruguay)
ACUC	Asociacion Colombiana de Usuarios de Computadores (Colombia)
ALADI	Asociacion latinoamericana de Integracion (Latin American Integration Association)
APPD	(Association of data processing professionals, Brazil)
ASBEMI	Associacao Brasileira das Entidades Municipais de Informatica (Brazil)
ASSESPRO	(Association of Data Processing Services Enterprises, Brazil)
AUTOMAT	(Program aimed at improving knowledge of automation, Argentina)
Bartel	Barbados Telephone Limited
BET	Barbados External Communications
Brasilsat	(Brazilian telecommunications satellite)

C&W	Cable & Wireless (a multinational corporation)
CANTO	Caribbean Association of National Telecommunications Organizations
CAPPEIPI	(Chamber of Small Enterprises of Pichincha, Ecuador)
CAPRE	(Coordination of Electronic Data- Processing Activities, Brazil)
Caricom	Caribbean Community
CARIRI	Caribbean Industrial Research Institute
CARITIN	(A subregional FUNREDES project)
CARTIS	Caribbean Trade Information System
CAST	College of Arts, Science and Technology (Jamaica)
CBI	Caribbean Basin Initiative
CCTA	Caribbean Cable Television Association
CDB	Caribbean Development Bank
CDCC	Caribbean Development and Cooperation Committee (ECLAC)
CEDP	Caricom Export Development Project
CEIS	Caribbean Energy Information System
CENAPIA	Centro Nacional de Apoyo a la Pequena Industria y Artesania (Ecuador)
CEO	Chief Executive Officer
CEPAL	Commissión Económica de la Naciones Unidas para América Latina y el Caribe (United Nations Economic Commission for Latin America and the Caribbean)
COMISEC	(National authority responsible for industrial renewal, Uruguay)
COPOIN	(National Informatics Policies Commission, Costa Rica)
CORPONDUSTRIA	Corporación de Desarrollo de la Pequenã y Mediana Industria (Venezuela)
CSTI	Centre for Technology Sourcing and Intelligence (CARIRI)

CTO	Caribbean Tourist Organization
CTU	Caribbean Telecommunications Union
CXC	Caribbean Examination Council
DB	Database
DEC	Digital Equipment Corporation
DINAPYME	(Small business support service, Uruguay)
DINFOPYME	(Program aimed at improving knowledge of informatics management, Argentina)
ECLAC	United Nations Economic Commission for Latin America and the Caribbean
EEC	European Economic Community
EI	(A school, Uruguay)
Embratel	(State Telecommunications monopoly, Brazil)
Empretec	Programa para el Desarrollo de Empresas de Base Tecnologica.
Fenasoft	(International Fair of Software, Hardware and Informatics Services, Brazil)
FINEP	Financiadora de Estudios y Projetos (A federal funding agency, Brazil)
FLAI	Federación Latinamericano dė Usuarios de Informática
FUNREDES	Fundacion Redes y Desarrollo (Dominican Republic)
GATT	General Agreement on Tariffs and Trade
GCE	General Certificate of Education
GDP	Gross Domestic Product
GNP	Gross National Product
GOJ	Government of Jamaica
H.E.A.R.T.	Human Employment and Resource Training Programme (Jamaica)
HAITI-L	(An electronic conference)

HND	Higher National Diploma (Trinidad and Tobago)
HRD	Human Resource Development
IAST	Institute of Applied Science and Technology (Guyana)
IBICT	Instituto Brasilien para Informcion en Cienceas y Tecnologia (Brazil)
IC	Information centre (CARTIS)
ICP	(Industrial Competitiveness Program, Brazil)
IDRC	International Development Research Centre
IGS	Imports of Goods and Services
ILO	International Labour Office
IMO	International Maritime Organization
IMPI	(Small business support service, Spain)
INET93	Internet Conference 1993
INMARSAT	International Marine Satellite
Interdata	(International data communications network, Brazil)
IPAL	Instituto para América Latina
ISO	International Standards Organization
ISSD	Information Sciences and Systems Division (IDRC)
IT	Information technology
ITC	Information Technology College (NIHERST)
ITU	International Telecommunications Union
Jamintel	Jamaica International Telecommunications Ltd
JAMPRO	Jamaica Promotions
JECC	Japan Electronic Computer Company
JTC	Jamaica Telephone Company

KISKEYA	(An electronic conference)
LA	Latin America
MAP	Microprocessor Application Project (Great Britain)
MERCOSUR	Mercada Común Sudaméricano (South American Common Market)
MIDA	Micro Enterprises Development Company (Jamaica)
MPAA	Motion Picture Association of America (USA)
MTCNC	Machine tools with computerized numeric control
MULBRI	(A PC-based interface to research networks)
NAFIN	Nacional Financiera (Mexico)
NAFTA	North American Free Trade Area
NAIC	National Advisory Informatics Committee (Barbados)
NCB	National Computer Board (Singapore)
NCST	National Council for Science and Technology (Jamaica)
NGO	Non-governmental organization
NIHERST	National Institute for Higher Education, Science and Technology (Trinidad and Tobago)
NRSE	New and Renewable Sources of Energy
OECD	Organization for Economic Cooperation and Development
OECS	Organization of East Caribbean States
ORT	(A school in Uruguay)
PACTI	Programa de Apoio à Capacitaçao Tecnologica da Industria (Brazil)
PNUD	Programa de Naciones Unidas para el Desarrollo (United Nations Development Programme)
Pro-IMPE	(Information Technology Programme for Micro and Small Enterprises and Professionals, Brazil)
PYMES	Pequena y mediana empresa (plural)

R&D	Research and development
RAS	Requirements Assistance Programme (Singapore)
RCP	(Peruvian National Network)
REDALC	(Information network for Latin America and the Caribbean)
REDID	(Dominican National Network)
REHRED	(Haitian National Network)
RENPAC	Rede Nacional de Comunicacao de Dados por Comunicacao de Pacotes (Brazil)
RHAE	Formacao de Recursos Humanos em Areas Estratégicas (Brazil)
RIOSOFT	(Software Export Centre, Brazil)
RTA	(A consulting company, Uruguay)
S&T	Science and Technology
SALSA	(An electronic conference)
SBDC	Small Business Development Company (Trinidad and Tobago)
SCOT	Social Carriers of Techniques
SEBRAE	Servico Brasileiro de Apoio às Micro e Pequenas Empresas (Brazil)
SECP	Small Enterprise Computerization Programme (Singapore)
SEI	Secretaria Especial de Informatica (Brazil)
SERCOTEC	Servicio de Cooperación Técnica (Chile)
SIE	Sistema de Informacion para las Empressas (SERCOTEC)
SOFTEX 2000	(A national programme of incentives to export software, Brazil)
SPM	Servico Publico de Mensagens (Brazil)
SRC	Scientific Research Council (Jamaica)
SSD	Social Sciences Division (IDRC)
STIN	National Scientific and Technical Information Network (Jamaica)

STM-400	Sistema de Tratamento de Mensagens (Brazil)
SUCESU	(Society of Informatics and Telecommunications Users, Brazil)
Telco	Telephone Company (Trinidad and Tobago)
Textel	Telecommunications Company (Trinidad and Tobago)
TIPS	Technological Information Promotion System (UNDP)
TNC	Transnational Corporation
TOJ	Telephones of Jamaica
Transdata	(Dedicated lines, Brazil)
TV	Television
UCUDAL	Universidad Catolica del Uruguay. Damaso A. Larranaga (Uruguay)
UFRGS	Universidad Federal do Rio Grande do Sul (Brazil)
Unctad	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
Unesco	United Nation Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
US	United States
USA	United States of America
UWI	University of the West Indies
W.I.	West Indies
WMO	World Meteorological Organization
XGS	Exports of Goods and Services

GLOSSARY

AGENDA 21	The global action plan resulting from the United Nations Conference on Environment and Development (Earth Summit), Rio de Janeiro, June 1992
AlterNex	An Internet access provider based in Brazil
ATM	Automatic teller machine: a self-service banking terminal available to the public to perform various transactions
BITNET	A worldwide academic computer network for electronic mail and file transfers
bps	Bits per second: data transmission rate in CMC
CAD	Computer-aided design: design of products using computers to perform some functions of the process
CAM	Computed-aided manufacturing: use of computers to control the manufacturing process
CD-ROM	Compact disk - read only memory: an optically-read compact disk that cannot be written upon
CIM	Computer-integrated manufacturing: the integration by computer of planning, management, and control of a manufacturing process
CMC	Computer-mediated communication: communication using one or more computers as essential components, for control of the transmission and reception of data as well as managing conversion between various formats of data representation
connectivity	The ability of two computers to be connected and transmit data to each other
Database	A collection of data organized to serve more than one application
EDI	Electronic data interchange: the exchange of data between users according to international standards and rules
freeware	Software for personal computers, developed by not-for-profit organizations or individuals, and supplied free of charge or at a

	nominal cost
GIS	Geographic information system: an information system based on geographically-referenced data
Internet	A global collection of interconnected international computer networks with common naming conventions
Information superhighway	Long-distance links between computers, capable of high data transfer rates
IS	Information system: a computer-based system that provides and distributes information
ISDN	Integrated services digital network: a digital telecommunications network operating under standards allowing it to carry representations of voice, data, images, and high-fidelity sound
just-in-time	Production of components in a manufacturing process at the moment required, to avoid the cost of carrying inventory
LAN	Local area network: a computer network located on a user's premises, within a limited geographical area
mainframe	A type of generally-available computer with the most extensive capabilities and resources
microcomputer	A type of computer based upon a microprocessor (integrated central processing unit on a single chip)
minicomputer	A type of computer intermediate between a mainframe and a microcomputer
MIS	Management information system: an information system supporting the information needs of management
OEM	Original equipment manufacturer: an organization making computers or other electronic products for incorporation in assembled machines
outsourcing	Turning over in-house computer operations to an external vendor of services
PC	Personal computer: a microcomputer designed for use by one person

SUBJECT INDEX