OCCASION

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

DISCLAIMER

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

FAIR USE POLICY

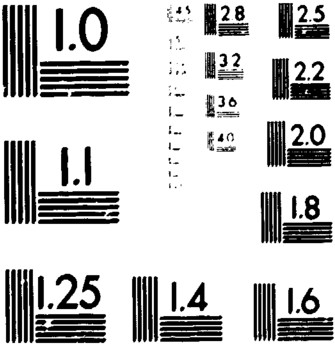
Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

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

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

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



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

14532

Distr.
LIMITED

UNIDO/IS.526
4 April 1985

ENGLISH

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATICN

SURVEY OF GOVERNMENT POLICIES IN INFORMATICS *

Prepared by

Regional and Country Studies Branch
Division for Industrial Studies

Juan F. Rada

* The designations employed and the presentation of material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area of its authorities, or concerning the delimitation of its frontiers or boundaries. Mention of company names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO). This document has been reproduced without formal editing.

V.85 24842

Foreword

Within the framework of UNIDO's programme of industrial studies, the Regional and Country Studies Branch of UNIDO carries out surveillance of structural change in industry. The objective is to provide information, analyses and conclusions that may be helpful to developing countries in designing their own programmes of structural adjustment in the manufacturing sector. The factors considered in such studies include consideration of the forces determining structural change in industry, including resource endowment, produce mix, factor proportions and changes in productivity, and the impact of technological change. The present document was prepared as part of a detailed examination of many aspects of industrial policy intended to provide background information to a particular developing country in its review of policy options. However, it is felt to be of wider interest and is therefore being issued in its present form.

The present document summarizes some recent developments in national informatics policy, especially in the developed countries. By so doing, it is intended to provide information on decisions now taken, and changes now under way, that will have important effects on the future structure of the informatics industry. It may thus be useful to policy-makers in this field in developing countries, in indicating the context in which their own development strategies may operate and the opportunities and obstacles which may be encountered.

However, the report deals with a rapidly changing field and a complete picture of technological change, government policy, and the interactions between them, in all countries and regions, is difficult to achieve. The document should therefore be seen only as a first step in this direction and will be supplemented by others as more information becomes available on particular countries and developments in key areas.

It should be noted that informatics is one of a number of key technological areas on which UNIDO's Technology Programme focuses in its work of promoting technological acquisition, implementation and development by the developing countries. The Programme collects and disseminates information, develops guidelines for acquisition and application, fosters exchange of technology and promotes international co-operation, especially between developing countries, in this field.[1/] Accordingly, the present study should also be seen as a complement to this activity.

This document is based upon a report prepared by Mr. Juan F. Rada, UNIDO consultant, with additional material by the UNIDO Secretariat. The contribution of UNCTAD, through the timely provision of data on tariff and non-tariff obstacles to trade in informatics equipment, is gratefully acknowledged.

1/ See for instance "The UNIDO Programme of Technological Advances: Microelectronics" UNIDO/IS.445, "Guidleines for Software Production in Developing Countries"UNIDO/IS.440 and "Microelectronics and Developing Countries" UNIDO/ID/EG.384.5.Rev.1, "Technological Advances and Development: A Survey of Dimensions Issued and Possible Responses" UNIDO/IS/WG.389/3.

TABLE OF CONTENTS

List of tables/charts/figures

Chapter 1

INTRODUCTION AND SUMMARY

This paper summarizes government policy in informatics in selected countries, mostly developed ones. It provides a brief review of decisions taken and programmes pursued at a national level in the United States of America, Japan, the Federal Republic of Germany, France, the United Kingdom and Spain. Policy in the European Economic Community is also summarized. With respect to developing countries, the situation in the Far East, in India and in Brazil is also examined.

Because of the rapidly changing nature of the underlying technologies, the first chapter contains a brief overview of trends in this area. These trends are determining the emphases of research and investment in the informatics field, and the first chapter provides, therefore, a summary of the technological context in which decisions are being taken. Succeeding sections of the report then outline the priorities adopted by the above countries, including when available an indication of the resources being committed and the expressed objectives of the national programmes. Due to the different role of the state in different developed countries and the importance and deep involvement of many large companies in this field, the paper also covers to some extent the relations between government and private industry and organizational developments with respe· : to research and application.

Another chapter then examines particular obstacles to international trade in informatics equipment, focusing on those obstacles which would be faced by developing countries wishing to enter this field. Drawing on several sources, but especially on data supplied by the UNCTAD Secretariat, it gives an account of quantitative and qualitative barriers applying to trade in the various informatics commodities. Quantitative barriers include tariffs, ceilings and quotas, and the focus is on the GSP (Generalised System of Preferences) tariff rates applied by developed countries to the exports of developing countries as well as on the tariffs of developing countries themselves. Qualitative barriers include government purchasing policies, technical standards, valuation principles and various measures resulting from sectoral targeting. Finally, some tentative conclusions for developing countries' informatics policy are suggested in the final chapter.

Chapter 2

TRENDS IN TECHNOLOGY AND ORGANIZATION

The intention in this chapter is to give a short outline of current trends in the component, computer and telecommunications sectors as it is within these contexts that national informatics policy can be understood.[1/]

2.1 Components

The important trend in components is the increasing level of integration. This means that more and more functions are being incorporated into the circuits, and it thus leads to growing economies in terms of price/performance ratios. The consequence is an increase in the amount of value added in the components, rather than in the assembly, of equipment. It also means an increasing trend towards firmware, i.e. software incorporated into the hardware. The immediate consequence is that there are substantial changes in the product mix of the industry. At the time of writing, approximately 85 per cent of the world production of integrated circuits (ICs) are standard products (e.g., RAMs) while, by 1990, this proportion could be reduced to perhaps 40 per cent or 50 per cent. This considerable change will affect the structure of the industry, and determine the size and nature of niches for late comers.

Not only will the importance of custom and semi-custom circuits increase considerably but it is also expected that C-MOS technology will become dominant in many fields. However, progress in design methodology, materials and manufacturing automation are essential to the processes. Manufacturing automation is critical to achieve economic yields as the level of integration increases to sub-micron resolutions.

1/ For a fuller account, see J. Bessant "Technology and Market Trends in the Production and Application of Information Technology", UNIDO Microelectronics Monitor, No.8, Supplement, December 1983.

At present, progress in semiconductors continues in all fields, including materials, capital equipment, process and packaging technology. Alternative approaches for systems are being pursued, and also for reduction of the memory gap (processing as opposed to electro-mechanical memory systems). Important approaches currently being explored are Wafer Scale Integration, Very High Speed Integration and Three Dimensional Chips. Specifications for the fifth generation computer programme in Japan, and similar efforts in Europe and the United States are based upon substantial progress in the next ten years. The 256K RAM is already on the market and the 32 bit economical microcomputer is available. Some producers forsee the introduction of the 1MB RAM in samples within a year or so.

However, the consequence of these processes is that although for many components the economies of scale have been reduced (by the use, for instance, of gate array techniques or single cell libraries), the capital requirements for manufacturing have increased substantially. For instance, Siemens Austria estimates that their step from from 16 to 64K chips required an investment of about 700 million schillings (about $33 million), whereas the step from 64 to 256K chips required almost 2 billion schillings (about $93 million).1/ The current state of the art includes 6 inch wafers, and almost fully automated production and assembly of high value added products will soon be a reality. This has organizational implications, and some large companies are integrating vertically into the production of critical capital equipment because of the demands of proprietary design.

The industry will also be substantially affected by some new entries into the merchant market. For instance, Western Electric, after the de-regulation of the AT&T system (on 1 January 1984), is free to compete on the open market. The first product that has been announced is a high speed 256K RAM. Western Electric is one of the largest producers of components but, until 1983, it had been a captive facility of AT&T.

1/ "Die Presse", 17 October 1984.

It is likely that other large captive producers of semiconductors will enter the merchant market and only retain a few highly sophisticated in-house lines. This is essentially due to the need to obtain adequate economies of scale and scope to meet the heavy capital investment requirements. As customization grows, one can expect an increase in the use of silicon foundry services, according as end users develop their own design capabilities.
Most importantly therefore it would seem that few countries and producers will be able to compete in standard products. The new entries can be expected in custom and semi-custom devices. At the early stages, design capabilities will be critical in this field.

2.2 Computers

In the computer industry a shock or "shake-out" appears imminent, since at present about 200 different companies are offering systems on the open market, and a similar number are also doing so behind some form of protective barrier. Not only have cases of bankruptcy occured in new companies, but, the fate of some large, previously successful producers is now in doubt. Restructuring of the industry is likely to accelerate as the convergence of computers with communications increases and the level of integration of components grows.

Underlying these changes is an essential transition from data processing to information processing. It implies the need to offer systems capable of fully integrated functions (i.e., data, word processing, routine office applications, graphics, report generations and, shortly, image processing for some important common applications) which communicate through local area neworks (LAN) with Ethernet or other standard equipment. Linked with these developments are new operating systems which are rapidly becoming standard, such as UNIX, hardware capable of high resolution graphics and, increasingly, 32 bit architecture for microcomputers. The points mentioned in this paragraph apply to open market products. The market has changed, together with the product, from being purely hardware oriented during the early stages of microcomputer marketing, to the present software and application orientation. Changes can be expected in all areas. Even for professional applications, the means of input is changing from the use of keyboard alone to combinations of keyboards, touch screens, and multiple input options, including speech recognition for some restricted applications. Substantial progress in speech recognition is expected within the next few years, and personal/business computers incorporating it are already available.

All the above developments, combined with the constant acceleration of processing speed, the search for expert systems and the telecommunications dimension that all systems will have, are severely taxing software capabilities. Profound changes are occurring, therefore, in the software development tools, with "software factories", the introduction of new, modular languages (such as Modula-2), increased emphasis on languages suitable for artificial intelligence applications (such as LISP and PROLOG), and general tools to facilitate human-machine interface (e.g., windowing, integrated software etc.)

Computers are becoming "universal" machines aiming at the transmission of information rather than simply data processing machines. This wider use is constantly enhancing the technology and is having also a considerable effect on peripherals, mass storage systems and interfaces. The changes include rapid development of low-cost, new generation printers (in particular, laser). The economic integration of several printing functions is now envisaged. This is being done by merging printing and photocopying into one machine, and also by the addition of colour. Competition in this field is accelerating rapidly. Changes are also taking place in storage systems with new standard 3 1/2 inch floppy disks, 5 1/4 inch Winchester hard disk drives, and optical disks. The peripheral "revolution" is being caused by totally new approaches on the technological side combined with unprecendented market fragmentation. The equipment market can no longer be seen as a single entity. It has many different segments ranging from tradition mainframe and mini to home computers, the professional workstation or computer, transportable and portable equipment. Each of these areas requires a different type of peripheral with different specifications of ruggedness, power consumption, functions and compactness. In addition, equipment such as printers will have to provide graphic capabilities including colour. The development of the video and compact disk, and the future erasable disk, is also opening new developments in peripherals, as evidenced by current changes in the video game markets. As the digitalization of sound and image proceeds, the convergence of computers with audio-video technology will create a new generation of peripherals. Needless to say, these developments are also putting pressure on CRT, video display and TV technology, but, while digital processing of TV signals is already available, a fully digitalized TV system will take longer. New display possibilities are emerging in the rapid development of LCD (Liquid Crystal Diode) screens which are both compact and low in power requirements.

This quick review serves only to point out that the process of technological change in this field is accelerating, together with rapid increases in investment, economies of scale and technological needs.

2.3 Telecommunications

The telecommunications sector has changed from a slow-growth sector based on traditional electromechanical technology to become the one with the greatest actual and potential growth. The numerous changes in this field are relatively well known. They range from new transmission equipment and systems, dedicated business satellites, private branch exchanges (PBXs) and an array of peripherals. Progress in all directions is envisaged. The development cost of the next generation equipment heralds an increase in industrial concentration. Indeed, the development cost of the next generation of public switching systems will be of the order of US $1 billion, with the bulk going into software development. These magnitudes have forced large corporations such as Philips and AT&T to join forces in order to ensure that they remain suppliers of telecommunications in the future. All telecommunications companies are entering into some form of partnership for the development of next-generation products.

What is of interest here is the new role that telecommunications are playing as an essential infrastructure for information-intensive services. They thus become the core of the technology system in electronics. All electronic equipment will potentially become part of the peripherals to large telecommunications networks. In this sense, communications will increasingly define the technological thrust of the electronic industry. This partly explains the new strategic positions of a growing number of companies, with IBM, AT&T, L.M. Ericsson, Olivetti and Xerox being very prominent. IBM, for instance, is now involved with chip making (Intel), PBXs (Rolm), and satellites (SBS), and has attempted to become involved in national telecommunications (British Telecom).

An analysis of this field would require a report of its own. The important aspect for public policy is that, due to the new role of telecommunications, policies in this field are not simply hardware-related but influence the entire services sector. Indeed, as more and more services can be transported via telecommunications, the technical standards, transmission rates, use of cable, etc. have an increasingly direct impact on the economics of services. In turn, restricted international telecommunications links amount to a policy of import substitution of serivces. The most notable public policy in this respect is that of Brazil but many countries are in the process of elaborating specific programmes and measures. The issues, often referred to as Transborder Data Flows, are the ones that motivated France to suggest a "World Communications Charter" in order to ensure a more balanced development of domestic informatics industries.

These changes reveal one fundamental fact: that we are not witnessing just the rapid growth of an industrial complex but rather a change in the entire productive system. In this sense, policy in electronics, whether it emphasizes components, computers or telecommunications, is a new industrialization policy to deal with new phenomena. But the success of such a policy is thus dependent on a recognition of the interdependence of these fields.

Chapter 3

GOVERNMENT POLICIES IN DEVELOPED COUNTRIES

3.1 Strategies and support

No area of current high technology has been developed without subtantial direct or indirect government support. For some time, governments in both developed and developing countries have understood that technological change is one of the means to maintain and enhance competitiveness. In the last few years this basic understanding has increased, and, since 1975, has led to a variety of public policies in information technology.

It is a commonplace to say that technology conditions comparative advantage, as manifested in the obsolescence of existing enterprises and their products, e.g., cheap mechanical articles. It may manifest itself in substitution of products or commodities, e.g., aluminium for copper for power transmission, or plastic for steel for cars; in productivity improvements, e.g., garment production; or in new products, e.g., pocket calculators or home computers.

Briefly, the evolution of technology can significantly alter patterns of comparative advantages (both within and between countries), capital formation and world-wide employment opportunities. The present situation is one in which technological innovation has, to a great extent, become a determinant of competitiveness rather than a condition. We refer here not necessarily to invention but to a broader concept of knowledge and hard/soft innovation applied to products, processes and services.

This perhaps needs clarification. The definition of innovation has long been a widely debated issue. But it seems that, at least for policy purposes, it should be understood as producing marketable products. This implies that originality or creativity in the basic principle of the product or process (often classified as invention) is not necessarily required.

At present the capacity to absorb technology creatively is highly dependent on skill-endowment, and on the dominance of some basic elements of product and process technology which allow assimilation as well as innovation. A classic example here is Japan's Very Large Scale Integration (VLSI) programme which denotes a shift from the modification and improvement of existing technologies to new technologies. In this case, the direction of the research effort was not original, as it was clear that higher density circuits were necessary and that a large market awaited them. It is, therefore, a case of qualitative improvement of existing technology.

This digression into the characteristics of innovation may clarify the nature of public policy, especially in relation to R&D expenditure since, although important, it is only one aspect of the "technological environment".

Over the last few years, official and other published reports, together with the policies implemented in most developed countries, clearly indicate the importance accorded to technology. Public technology policy refers to the role played by governments in shaping the environment in which innovation takes place. It also includes the guidance and nurture of the process of public or private technological development. From a global point of view, these measures have led to the existence of country policies rather than simply company policies in areas of advanced technology. This has three basic effects:

Firstly, there is an acceleration of the process of innovation, though not necessarily invention, due to increased competition whether because of demand pull or technology push. Seondly, there is an acceleration in the process of diffusion of new technologies. Lastly, governments intervene actively, particularly through special credits and similar arrangements, to help their companies export to global markets.

Before entering into details, it is necessary to make a rough distinction between <u>government strategies</u> and <u>government support</u> as two different approaches to public policy in technology. <u>Strategy</u> covers the search for synergy between different actors in any given area of technology and the attempt to map out the stages from R&D to markets. This can take the form, for instance, of supporting R&D and, at the same time, utilising public sector procurement policies that will operate as a captive market for the products resulting from the R&D. The case is similar when governments encourage mergers, take-overs and other forms of streamlining to achieve international economies of scale. This type of strategy is always reflected in some form of industrial policy. In Europe, most developed market economy countries fall into this category. EEC members sometimes co-ordinate through the EEC Commission, as in the case of steel, chemicals and textiles, and increasingly electronics and information technology. In terms of strategy, Japan is a classic example where the difficult task of overall co-ordination is provided by the Ministry of International Trade and Industry.

Support is the disbursement of public funds to the private sector or public companies without any special type of co-ordination or mechanisms for industrial synergy. This can take the form of government procurement for specific industrial products, government contracts for development as well as production, or the sponsoring of research in support of government programmes. The intention in all cases however is primarily the supply of products for the government programmes in question and the benefits to the industry are in this sense secondary, even though they may be significant in terms of a boost in demand and a strengthening of technological capacity.

With respect to the informatics industry, the effects of government support are most obvious in terms of defence, space and telecommunications expenditures. This means that in several developed countries, the informatics industry is the focus of a combination of strategy and support measures.

Naturally these are rough categories since situations vary from sector to sector. The trend, however, is evolving slowly in all countries towards strategies. This is particularly the United States case where the private sector, through industry associations (e.g. the Semiconductor Industry Association) or the activities of private companies, is seeking the development of strategies or preferential treatment from the government. In the last few years there has been an increasing number of institutions in the United States calling for the development of some form of industrial policy, particularly in the area of high technology.

R&D is a necessary but not sufficient condition for innovation as previously defined. It can, and often does, lead to the understanding of new principles but not necessarily to new marketable products.

While the figures are not wholly comparable, it is estimated that overall R&D expenditure as a percentage of GDP in 1979 was 2.4 per cent for the United States and the Federal Republic of Germany, 2.2 per cent for the United Kingdom, 2.1 per cent for Japan and 1.9 per cent for France.

Comparing actual expenditure, the United States's R&D in 1979 was 1.45 times that of the EEC, and Japan's 0.45 times. These expenditure figures include military R&D. If this is excluded, then in relative terms civil R&D in the United States was 1.1 times that of the total EEC in 1979, and that of Japan was about half that of the EEC.

In terms of public financing as a percentage of total R&D, the share in the United States was 52 per cent in 1979, that of the EEC 48 per cent and that of Japan 29 per cent.[1/]

Table 1 shows the origins of funds for industrial R&D in the electrical and electronics group in 1979.

1/ "Government Financing of Research and Development 1975-1983". Statistical Office of the European Communities, Luxembourg, 1984.

Table 1: Expenditures in R&D in electrical and electronics industries, 1979
(in billions of US dollars)

Country	Total	Government Funds	Private and Abroad
United States	7.92	3.41	4.51
Japan	2.44	0.02	2.42
FRG	2.18	0.29	1.89
France	1.16	0.29	0.88
United Kingdom	1.07	0.59	0.48

Source: OECD Science and Technology Indicators: Resources Devoted to R&D, OECD, Paris, 1984, p.122 Table 2.40

This expenditure group includes electrical machinery, electronics components and communications equipment industries but not computer manufacturers. Some indication of relative research strengths in the latter area can be seen in Table 2, which shows the number of researchers in the computers and office equipment industries in 1978.

Table 2: Numbers of R&D scientists and engineers in the computer and office equipment industries, 1978
(thousands)

United States	41.1
Japan	4.8
Federal Republic of Germany	-
France	2.5
United Kingdom	5.1

Source: OECD Science and Technology Indicators: Resources Devoted to R&D, OECD, Paris, 1984, p.125, Table 2.42.

3.2 United States of America

The direct role of the United States government in the development of the informatics sector is very limited (as in industrial policy generally). The sector is characterized by strong and innovative companies where research, manufacturing and marketing skills and activities have dominated the sector worldwide. They have, indeed, formed much of the background against which government policy in other countries has been developed.

However, indirect support has been provided to the industry though public programmes in the fields of defence and space, as well as through a particular legal and fiscal framework that has had important effects on the company organization and growth. The defence and space programmes contributed greatly to the early development of the semiconductor industry, and as in some other industrialized countries remain important to electronics companies in terms of demand and R&D support. But it has been noted by the President's Commission on Industrial Competitiveness that this no longer pushes civilian research and development,[1/] even though progress since then has been based on the expansion of civil and commercial markets. For instance, the microprocessor, a crucial component, owes its development to commercial reasons, having been developed to contain the arithmetic functions of a calculator.

One major programme of the Unied States Department of Defence that can have a direct bearing on the informatics sector by increasing the technological capability of private firms is the Very-High-Speed Integrated Circuit Programme (VHSIC). Phase 1 from 1978 to 1984 amounted to around $340 million and a similar amount is scheduled for the second phase (1985-1989). Phase 2 is directed towards the achievement of submicron feature on circuits and to greatly increase computation speeds.[2/] The target is thus similar to the current programme in the Federal Republic of Germany. Indications are that the VHSIC programme is making successful progress.[3/]

1/ "America's High-Tech Crisis", Business Week, 11 March 1985.

2/ D. Ypsilanti, "The Semiconductor Industry", OECD Observer, January 1985.

3/ "VHSIC hits new levels of acceptance", Electronics Week, 25 February 1985.

As to other measures the government in its application of anti-trust legislation to constrain the entry of AT&T and IBM into the merchant market may be said to have indirectly favoured the development of the informatics industry in general, since space for new entries was thus created. Furthermore, government policy would have been irrelevant if it had not been combined with other factors such as liberal licensing of transistor and integrated circuit technology, high mobility of technical personnel and availability of venture capital.

On the last point, there has been a noteworthy concentration of venture capital in the electronics sector. The share of total venture capital directed towards computers, microcircuits, telecommunications etc. rose from 63 to 67 per cent of the total between 1982 and 1983, with telecommunications increasing its share the most rapidly. Outside electronics, the next highest share was in the medical field, at only 9 per cent.[1/]

With respect to telecommunications, the United States situation is different to that of other countries, since they are privately owned, and thus not a mechanism for industrial policy as in Europe or Japan. The recent de-regulation of the United States telecommunications market, together with the division of the Bell system and the abandonment of the anti-monopoly case against IBM, will substantially increase competition between these groups. With a few exceptions, the telecommunications market in all advanced countries is the reserve of national or state-owned producers. From this point of view, the United States is among the most open.

1/ "Echange International et Effort Technologique", Conjoncture, December 1984, reproduced in Problèmes Economiques", No.1.912, 20 February 1985.

Another feature that is unique to the United States, is the form of customs regulations, particularly items 806.30 and 807.00, which tax only the value added abroad and materials obtained abroad of products partly manufactured in the United States. These custom rules are applicable to a range of products and have permitted the assembly of devices off-shore, especially in South East Asia. It is not possible to quantify the extent to which this exceptional rule has helped the industry, but it is commonly recognized that, without it, only a few large producers would have been able to compete on a worldwide scale. No competitor of the United States benefits from such an arrangement except for foreign companies operating from United States soil. This arrangement has helped United States industry to counterbalance some of the Japanese structural advantages (i.e., cost of capital) as well as lower labour costs.

Other important aspects of the institutional framework include a 35 per cent tax credit granted to corporations for incremental increases in R&D expenses over an historical base. In addition, 65 per cent of corporate research sub-contracted to universities can be included in the base and this is subject to incremental tax credit. The potential saving for the United States components industry over a period of five years (1982-1987) is estimated to be between $150 and $175 million. Another development has been the so-called "Apple Bill" which will write off taxes to companies donating personal computers to schools, universities and other educational institutions.

With greatly expanded competition in world markets and a growing import penetration in the United States, pressures are now increasing for a more active role for government in the informatics field. The report of the President's Commission on Industrial Competitiveness, already referred to, has supported the establishment of a cabinet-level Science and Technology Department and also a Trade and Industry Department. Whether such a source is followed or not, there is certainly a trend towards a more co-ordinanted approach. The Semiconductor Research Co-operative is funded by a consortium of about 35 companies, including major computer and component manufacturers. It was established in 1982 and had a budget of $13.5 million in 1984, sponsoring generic research in 54 areas at around 40 universities.1/

3.3 Japan

Japan's government support to the successtul and growing informatics industry has taken many forms, but the contribution has been as much and perhaps more in organization and co-ordination as in simple expenditure.

The most important programme since 1976 has been the Very Large Scale Integrated Circuit (VLSIC) resea .h effort. This programme was jointly sponsored by MITI and Nippon Telephone and Telegraph (NTT) with a 4-year budget of about $135 million, although the total figure more than doubles when company contributions are taken into account.

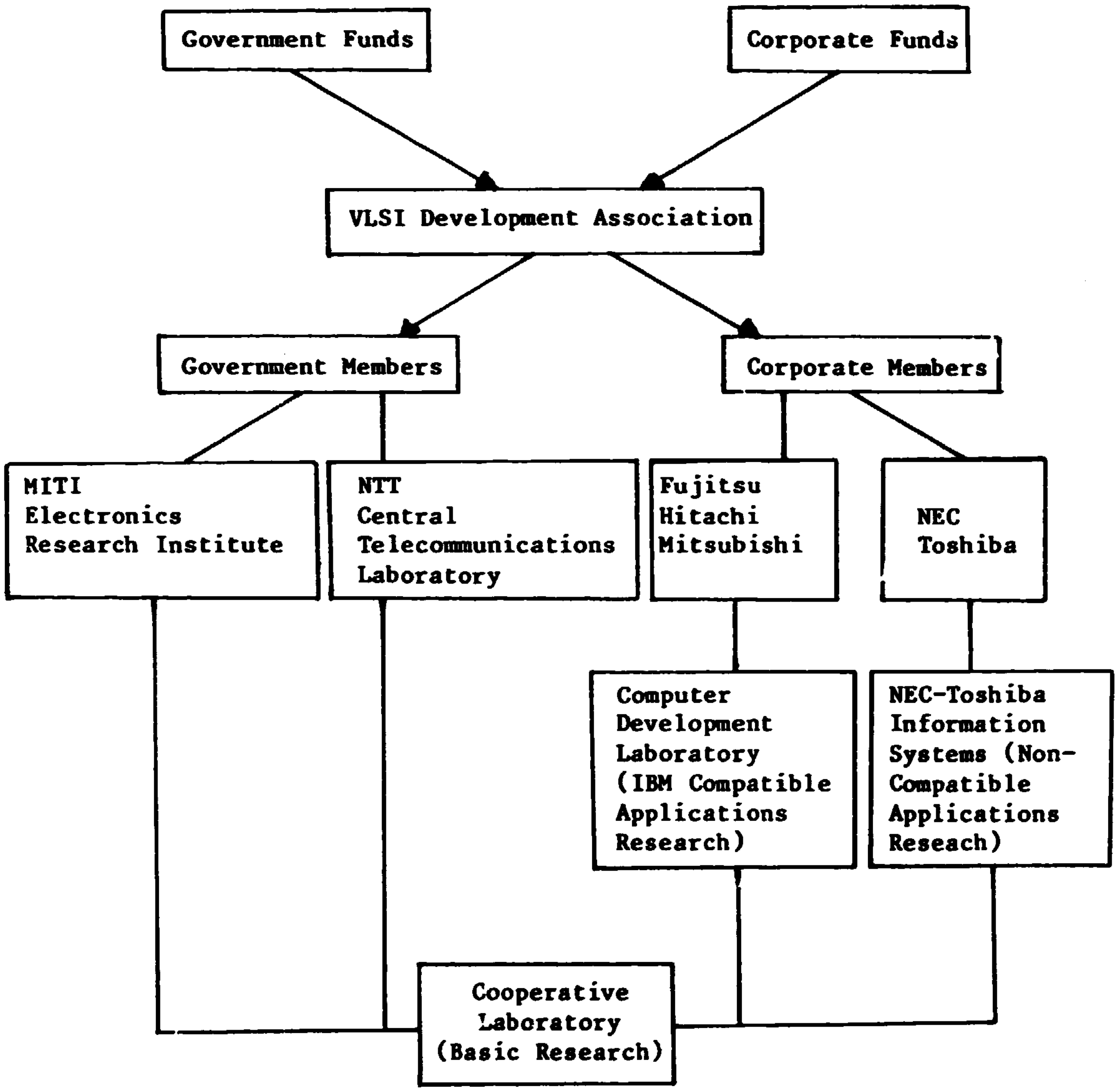
During this programme, which ended in 1979, basic research was conducted in a joint laboratory of the VLSI Technology Research Association formed for the programme by MITI and NTT. Two other laboratories were created by the manufacturers to pursue applied research.

The organization of the programe is shown in Chart 1.

By the end of 1979 the VLSI Association had developed 700 patentable technologies, including improvements in electron beam lithography, crucial for competition in state of the art devices, particularly high-density memories. Licenses from some patents that resulted from this programme have been denied to non-Japanese companies for a period of time. Until 1978 foreign companies were excluded from licensing VLSI patents developed by the VLSI programme.

1/ UNIDO Microelectronics Monitor, Issue No. 12, October-December 1981.

Chart 1: Organization of Japan's VLSI project



Source: Japan Agency of Science and Technology as quoted by Semiconductor Industry Association, "The Effect of Government Targeting on World Semiconductor Competition", California, 1983.

However, as Japanese industry becomes internationally competitive this type of attitude is being relaxed considerably. Signs of this relaxation are the decrease of tariffs for semiconductors to parity with the United States, the purchase of equipment from foreign suppliers by NTT and the latest announcement that IBM-Japan will be allowed to participate in some areas of the fifth-generation computer programme.

In 1979, another programme was launched in the software area with a new body especially created for it, the Electronic Computer Basic Software Technology Research Association (ECSTRA) with all manufacturers involved, as well as the two application-oriented laboratories of the VLSI programme. In addition, the Government has continued its policy of support to key technologies as outlined by the 1978 amendment to the electronics law. This includes three main areas: a) prototype R&D with a total of 35 items, including high performance digital computers, laser equipment and integrated circuits; b) commercial production with a total of 12 items including high performance remote processors, facsimiles, bubble memories, mass storage systems, liquid crystal displays, and c) manufacturing improvement with a total of 41 items including digital computers, electronic switching systems and magnetic recording. The 1978 law will remain in force until 1985.

At the end of 1981, Japan unveiled the plans for a fifth-generation computer system which has caused considerable debate in the industry. The project is similar to previous ones in structure as it is a joint government/industry/university effort. Government funding is expected to be about $400 million over a number of years with industry supplying a larger amount. The target is to improve the power of computers 10,000 times over the next nine years. The fifth-generation computer programme currently underway, aims, in terms of VLSI architecture, at an interim target of one million transistors per chip and a final target of ten million transistors per chip. In terms of design the programme includes a target in intelligent computer-aided design systems for VLSI that will allow designers to produce a working pattern for custom chips with one million transistors in one month. The drive of the programme is essentially related to substantial improvements in the human-machine interface with speech and pattern recognition, and language translation. A summary of past and present programme of government support, is given in Table 3 and of aspects of the fifth generation project in Table 4.

Table 3: Japanese national information technology projects

Project	Budgeted amount (million dollars)	Time frame
1. Very high performance computer systems	45	1966-71
2. Pattern information processing systems	90	1971-80
3. VLSI technology	135	1976-83
4. Basic technology for fourth generation computer systems	100	1979-83
5. Optoelectronics applications systems	90	1979-86
6. Basic technology for next generation industries	450	1981-90
7. Very high speed computer	100	1981-88
8. Fifth generation computer systems	450	1982-91
9. Intelligent robots	90	1984-91

Source: Computer Weekly, 27 September 1984.

Table 4: Some Japanese research budgets for Fifth Generation Project (millions of yen)

	1982	1983	1984	Total to date	1985
Inference subsystems	60	510	890	1,460	820
Knowledge-base subsystems	70	710	830	1,610	950
Basic software systems	120	610	2,230	2,960	2,330
Development support systems	140	840	1,120	2,100	900
Miscellaneous	30	50	50	130	60
Totals	420	2,720	5,120	8,260	5,060

Source: Computer Weekly, 27 September 1984.

It should be noted that the first targets of the fifth-generation project have already been achieved, with the completion of a relational data base machine,[1/] and, further, that plans for sixth-generation computers have already been made, including the study of inference mechanisms and thus areas of psychology, linguistics, and communication science. It is expected to start in two to three years time.[2/]

All these programmes in Japan are rather recent, but Japanese industrial policy in electronics originated in the 1950s and is characterized not only by its selection of specific technologies and sectors but also its continuity. As early as 1957, policymakers identified electronics as a priority sector, and passed legislation that was called "Extraordinary Measures for the Promotion of the Electronic Industry". Since then, the development has been rapid and accelerated

---

1/Electronics, 31 May 1984.

2/Computer Weekly, 27 September 1984.

after the 1973 oil crisis which forced Japan to reassess its industrial strategy. Knowledge-intensive industries, with high value added, were considered as the key to future growth. This is further reflected in the current MITI "Vision for the 80s" which also includes genetic engineering and materials technologies.

Japanese strategy can be said to comprise fierce competition among producers in the home and external market, coupled with co-operation, sometimes forced by the Government through the Ministry of International Trade and Industry (MITI), particularly in R & D. The continuity and coherence of government policy is expressed in four main sets of measures or policies that have been followed, the first being in the early 1950s, with the development of a new institutional infrastructure that supplemented the existing one. To this effect the Machinery and Information Industry Bureau was created within MITI together with new advisory bodies, the Electronic Machinery Industry Council and Data Processing Promotion Council, which act upon the request of MITI to deal with technical and policy questions.

Specialized Government laboratories were set up, such as MITI's Electro-Technical Laboratory and Nippon Telephone and Telegraph's three Electrical Telecommunications Laboratories. By 1981, there were a total of 10 specialized institutions including the Information Technology Promotion Agency, the Japan Computer Usage Development Institute, etc. The role of these institutions varies. Some have very specific tasks such as the VLSI Association, that was described earlier, while others have consultancy functions. In essence, they serve to facilitate co-operation between government, industry and academia, and financial institutions.

Secondly, under the guidance of MITI, the industry was rationalized, particularly since 1971, when the different producers were obliged to specialize as a condition for achieving excellence and international competitiveness in targeted technologies. There were three targets in 1971: 1) technologies demanding special R&D efforts, including digital computers and integrated circuits; 2) technologies open to economies of scale; and 3) technologies requiring modernization of production processes to achieve quality and reduce cost, although the product might have reached some degree of technological stability (e.g., computer peripherals).

Thirdly, the Government provides financial benefits through preferential procurement, credit allocation and tax incentives in R&D, in depreciation, and in training of information processing engineers. Special measures were taken to promote exports.

Finally, the trade and foreign investment policies were aligned to serve the targeted sectors. This expressed itself in high tariffs, in quotas and registration requirements, and in customs practices and procedures, accompanied by a consistent "buy Japan" policy. These latter have been considerably relaxed in the last three years as the industry has not only become competitive on a worldwide basis but has even surpassed United States industry in some areas of technology.

It is tempting to conclude from this package of measures, the complexity and intricacies of which cannot all be covered here, that Japanese performance is due to government policies. This obviously is not the complete picture: the amount of money for support is small as compared, for example, to the United States. The best support would have been irrelevant without a base from which to operate. This base is composed of the companies which, as explained earlier, share the bulk of R&D expenditure, albeit with generous tax incentives. Perhaps the most important lessons from Japan are essentially the following. Firstly, the concept of <u>target technologies or sectors</u> permits concentration of efforts and resources leading to a common goal, thus allowing a degree of industrial synergy in R&D, and among producers and suppliers. Secondly, the Government accelerated rather than substituted market forces.

The public sector in Japan operates with a long-term vision which private industry often lacks due to pressing short-term matters. This strategic planning process includes dynamic technology assessment and projection which is characteristic of Japan but is also becoming increasingly important in countries such as France and the Federal

Republic of Germany. More often than not, it is the military rather than the planning or industrial ministries that is the only state organ engaged in serious technology prospection.

Currently, Japanese policy (which is well documented in the MITI publication Vision of the 80s), takes into account the growing convergence of all electronic sectors due to digitalization, and it therefore aims at closer co-ordination between the various sub-sectors of the industry. Conceptually, the link that unifies the policy is communications. This is the essential element that will condition future developments in electronics. Today, in the field of communications, Japan has the most ambitious programme of all advanced countries. It aims at having broad-band optical digital transmission operable throughout most of the country by the 1990s. The rationale is that the existence of the infrastructure will create the "home market" for the future global competition, with computers, facsimiles and office equipment being "peripherals" of broad-band communication networks. The emphasis is, therefore, on the communications aspect of all types of equipment, including products such as machine tools, which were previously beyond the scope of electronics but which now incorporate them. As a natural consequence of this, Japan is pursuing a forceful policy both in the software and in the contruction of data bases to provide the "content" to be circulated through the networks. Of particular importance in this field are not only traditional applications but also the development of data bases in fields such as CAD, machining data bases, on-line robotics programmes and general areas where the emphasis will move from hard- to software, or from discrete products to systems (e.g., Flexible Manufacturing Systems). Once again, Japan is basing its strategy on the assessment of technological trends rather than simply trying to emulate the current state of the art. There are of course structural characteristics of the Japanese system and economy that favour the implementation of such long-term vision, in particular the way in which their capital market works, the manner in which industry is financed, and the respected nature of public administration, but the fact of this strategy must be of interest to many countries.

3.4 Federal Republic of Germany

In Europe, many efforts have been made to rationalize the industry and compete in electronics. As yet, there has not been the same degree of success as in Japan. This is partly explained by hard and soft variables, ranging from the behaviour of the financial market to management systems and the historical structure of the electronics industry.

In the case of the Federal Republic of Germany, the support from the Ministry for Research and Technology for electronics is indicated in Table 5.

These programmes have included training, applications, research, peripherals and software, grouped under the broad concept of informatics, as is the case for Japan and other countries including France and the United Kingdom.

Table 5: Federal Republic of Germany Support for Electronics

Programme	Period	DM million
1st programme	1967-1970	386.6
2nd programme	1971-1975	2,409.9
3rd programme	1976-1979	1,574.9
	Total 1967-1979	4,371.4
Current programme[a/]	1984-1988	3,000.0

Source: Fabre, J.J., and Moulonguet, T., "L'industrie Informatique" in Nora, S. and Minc, A., "L'informatisation de la société", Vol. II, Annexe 7, p.60, 61.

a/ Announced in March 1984, as reported in Financial Times, 9 March 1984.

The overall total for data processing, electronics, components, communication and documentation is US $1,768 million between 1978 and 1982.

The main objective of Federal Republic of Germany policy in electronics has been to attain technological independence by developing a strong domestic industry in specific market niches. The means used have included systematic support to the national industry through R&D grants and favourable public procurement policies. State intervention has accelerated since 1970, concentrating initially on technical training, research, especially in components, aid for small computer systems and research in new applications. The support to electronics is handled almost exclusively by the Ministry of Research and Technology.

This Ministry does not publish the list of companies which receive financial grants nor details of the specific R&D programmes they support. However, one programme on VLSI was started in 1980 with overall funding, including company funds, of about $300 million. It is estimated that the largest percentage has gone to Siemens, AEG-Telefunken and Valvo, a wholly-owned subsidiary of Philips. The companies participating in the programme can do so independently or in conjunction with other producers, including foreign ones.

In general, public policy in Germany operates through a loose form of consultation among industry, government and unions rather than through formal institutional arrangements. R&D allocations are made after consultation with all concerned and the Ministry for Research operates as an informal clearing house for this aspect of industrial policy.

Public procurement is an integral part of public policies especially from the Bundespost (the German PTT) as well as for defence, aerospace, public agencies and universities.

From 1975 onwards a number of programmes were begun to support the diffusion of electronics within small- and medium-sized enterprises. The view was that these enterprises would not be able to adopt the technology quickly enough without state promotional action. This question is particularly important in Federal Republic of Germany where the core of many industrial sectors (such as precision engineering and machine tools) comprises many small and medium-sized enterprises with a relatively high level of technology. Programmes in this field are the responsibility of the Ministry for Research and Technology and the Ministry of Economic Affairs. State programmes give support to co-operative R&D, innovative efforts by groups of companies sharing common technologies, and individual enterprises. The co-operative efforts have the advantage of pooling resources and ensuring a wide diffusion for new developments. The link between state programmes and industry is normally made through a centre of technological excellence which can be private or attached to a university. One example is the Technology Centre in Berlin (VDI) which is a private institution supported by the Ministry of Research and Technology. Created in 1978, during the first three years of its operation it received 700 requests for assistance from industry and spent approximately 60 per cent of its budget in supporting microelectronics applications. Another example is the Kernforschungszentrum in Karlsruhe which receives approximately DM 40 million a year to support industry in CAD/CAM and Flexible Manufacturing.

Support for large-, medium- and small-sized companies is a key aspect of policy in the Federal Republic of Germany because it ensures that the entire system is supported and that the risk is spread over a greater number of investments. This is contrary to previous policy which tended to support and build "national champions".

The programme recently presented to the Cabinet by the Ministry of Research and Technology in co-operation with the Ministries of Defence, Economic Affairs, and Post and Telecommunications, calls for a total investment of DM 3,000 million from 1984 to 1988. Half of this amount will go to support of research in advanced microelectronic components and high performance computers. The private sector will collaborate closely in the efforts and has pledged funds to complement the state finance. The programme also includes additional support to microelectronics and informatics applications, computer aided engineering, robotics and sensor devices. The programme includes suggestions for expanding training schemes, encouraging venture capital, adaption of public procurement policies and the development of a coherent long-term telecommunications strategy. This latter point is similar in concept to the Japanese strategy.

3.5 France

French public policy has been built upon two basic pillars. The first is support of national industry through grants, forced reorganization and public procurement polcies. The second has been the development of international connections, especially to obtain technology.

The initial direct programme of support to local industry started in 1966, and became known as the "Plan-Calculs". This consisted of an administrative structure and support to companies. The institutional arrangements include actions by bodies such as the Mission Informatique attached to the Ministry of Research and Industry, and the Ministry of Telecommunications. The institutions co-ordinate strategy between the government, universities and industry. They design the overall plans and produce detailed studies upon which public policy is based. In addition, the Institute for Informatics and Automation is essentially in charge of training high-level specialists, and promoting and conducting research.

The past record of French public policy shows that it often leads to considerable success, the most important example being the development of the civilian aerospace industry.

The impact of three successive "Plan-Calculs" has been an excessive support of mainframe computers, to the detriment of components, peripherals and small computers. This situation has now been changed, and the state has adopted a much more active role in defining research strategies. In quantitative terms the first two "Plan-Calculs" can be seen in Table 6.

Between 1975 and 1979, the third stage of the Plan Calcul was supported by FF 4,300 million. A characteristic of the last Plan Calcul period up to 1982 was the policy of supporting "national champions". The French electronic industry was to be reorganized around four poles, including technological ties with foreign companies. Companies following this latter course were Matra, Thomson, CGE and St. Gobain. The policy was changed in 1982 but the need to develop a central core of industrial and technological capability around the four reorganized poles of computers, telecommunications, components and consumer electronic was maintained.

Table 6: French expenditure under the Plan-Calculs
(in million French francs)

	1967-1970	1971-1975
Subsidies to the informatics industry	480	750
Aid to peripheral and components	120	160
Training	-	420
New applications	40	120
Telecommunications	-	256
Research	85	200
	725	1,906

Total 1967-1975 = FF 2,631 million

Source: Fabre, J.J., and Moulonguet, T., op.cit., p. 19.

The new "filièré éléctronique" programme envisaged a total government effort of FF 140 billion over a period of five years. The objectives are to become the world's third electronic power (after the United States and Japan), to obtain a positive balance of payments at the end of the five-year programme, to create 80,000 new jobs in the electronic sector, and finally to increase annual production by 9 per cent. The French programme is still subject to considerable debate and to revisions from both inside and outside the Government. This may imply that a clear picture of its final form, objectives and priorities has not yet emerged in many areas. This is also explained by the fact that the programme covers a wide range of fields and thus can be regarded as far more comprehensive than other European programmes. The inherent complexity of the programme is further complicated by the fact that key companies were nationalized in 1982 leading to changes in management and in relations with government and other companies.

Research is a key component within the general programme. It has the following objectives:

- To obtain a technological leap forward in new products and services. (The current strong French international position in "smart cards", which are credit, payment, and other identification cards containing their own memories, is evidence that progress is being made in this area).

- To link closely industry to public laboratories.

- To obtain concrete results such as demonstrable prototypes and experimental services in the short- and medium-term. (Advances are already visible here, particularly in the area of new services).

Underlying these general objectives are the priorities that are given to projects which can have a potentially large global market in the medium and long term and can integrate the strategies of several companies. Different task forces have been defined in specific areas to develop the guidelines for national programme. They range from Computer Aided Design for integrated circuits to Computer Assisted Translation. In terms of more specific industrial policy, the general guidelines defined follow the criteria listed below:

- To avoid abandoning any electronic sector but to pursue a more selective policy within them.

- To reinforce industrial policy to support the current strength of the French industry in telecommunications, telematics and professional electronics.

- To consolidate the current position in components.

- To develop the service and software industry.

- To ensure a French presence in medical electronics.

- To continue the development of the space industry in the context of European programmes.

The French programme tries to tie together supply and demand by putting special emphasis on applications and on users of technology. In this sense, the programme is a general tool for industrialization rather than one aimed at simply reinforcing a single sector, however important. Three areas deserve special attention:

- Industrial applications: diffusion of the technology into products and processes. In this respect, programmes for the reconversion and modernization of specific sectors have explicit objectives in terms of the use of electronics in areas as diverse as domestic equipment, textiles or garments. Specific programmes have been developed for the capital goods sector, including machine tools, robotics, flexible manufacturing and heavy equipment.

- Quantitative and qualitative objectives for the application of informatics to the public sector.

- Horizontal programmes in terms of training, awareness and evaluations of the social implication of technology.

There are many distinctive features of French policy when one compares it to those of its main competitors. Historically, one of the most important aspects is the intervention of the state to change the structure of industry by forcing mergers and take-overs. There is also the French state's policy of direct intervention in negotiations with foreign companies (e.g., the merger between CII and Machine Bull, and the subsequent joint venture with Honeywell). Today, the most important difference is that the key conglomerates in the field are owned by the state. This allows a different relation among companies, different types of access to capital and to the public sector markets. In this sense, the current situation is substantially different from previous electronic policy in France. Besides this key structural difference, the policy puts emphasis on services, particularly new knowledge- and information-intensive ones. France and Japan are thus the two countries with the most explicit policy in this respect.

As part of the EEC, France has also followed a policy of encouraging regional co-operation with joint programmes and also of trying to set up partnerships with electronic companies in different fields. This has not been successful for the current generation of consumer electronics (e.g., VCRs) but some progress is reported in telecommunications, office equipment and satellites.

The following two areas have been selected by France as priority sectors for international action beyond the boundaries of the EEC:

1) The search for international technology agreements among developed countries' governments and industries whether public or private. The areas for agreement include information technology, biotechnology and underwater technology. This is in line with previous French experience for breaking through high-technology areas using international, particularly European, co-operation. Examples are the Ariane satellite launching programme and Airbus Industrie.

2) There has been a call by the French Government for an "international communications charter", that should be to communications what the "law of the sea" (still to be approved) should be to the use of sea and marine resources.

The "international communications charter" initiative reflects the rapid process of internationalization of services, their transportability and the changing nature of information flows. The lack of mandates of existing international organizations in this area is seen by the French authorities as a threat to balanced developments in information technology.

Table 7: United Kingdom support for information technology

	million pounds
INMOS (components)	90 (1978-82)
ICL (computers)	215 (1981)
Robotics	10 over 3 years (1981)
CAD/CAM	6 over 3 years (1981)
Microelectronics Application Programme (MAP)	55 over 3 years (1978) - now extended
Software products scheme	5 committed (1982)[a]
IT Training centres	9 over next 2 years (1981)[a]
Fibre optics	25 over 5 years (1981)[a]
Microelectronics Industry Support Programme (MISP)	55 over 5 years (1978)
Space technology	50 for over 2 years, 15 additional in 1982 budget
IT equipment and systems	80 over 4 years (includes some of above - micros in schools, IT centre, software products)
Capital allowances for purchase of teletext and view data televisions	

Source: Based on Braun, E., Hoffman, K., and Miles, I., "Microelectronics and Government Policies: The Case of a Developed Country", UNIDO-ECLA Expert Meeting, UNIDO, Vienna, 1982.

Note: a/ = 55 million pounds extra allocation in 1982 budget.

3.6 United Kingdom

For some time, the importance of the informatics field has been recognized in the United Kingdom, and this has taken the form of many initiatives over the years. These have included the encouragement of mergers in the computer field, new state enterprises, the stimulation of research, assistance to industry in the application of the new technologies, and regional development programme (Scotland) specifically intended to attract industries in the electronics fields. These initiatives stem from an appreciation of the need to maintain and improve competitiveness, to maintain national capabilities in essential fields and to build upon the existing scientific and technological base.

An important initiative was the creation of Inmos, a state-owned microelectronics company whose purpose was specifically to build up new national capabilities in this field. Its early difficulties appear to have been overcome and its outputs include both mass market products (dynamic memories) and innovative circuits known as transputers. This venture was possible because the State Technology Group provided strong financial backing and also because the technological base existed through the presence in the company of top designers with substantial managerial experience. Government policy, now is to privatize state-owned industry, and a majority of Inmos shares have been sold to the British company Thorn.[1/]

The Microprocessor Application Project (MAP) funded with about £55 million aims to encourage the use of microelectronics beyond the borders of the electronics industry. This programme has been extended for another 3 years (up to 1985). It operates by encouraging companies to look at microelectronic applications by paying $4,000 towards the cost of hiring a consultant, and by a grant of 25 per cent of development costs of any products involving microelectronic applications.

The other aspects of public policy are similar to those of other countries, namely, discriminating purchasing policies and R&D support, particularly through academic institutions. An ambitious programme to provide schools with micro-computers is also under way. The British computer manufacturer, ICL, has also received considerably support from the Government, and its formation from smaller companies was encouraged.

1/ European Trade Union Institute "European Industrial Policy for the Electronics and Information Technology Sector", Brussels, September 1984.

The partial de-regulation of telecommunications and the privatization of British Telecom[1/] will however have effects both on procurement and on the stimulation of new supplies and users, but the extent of this cannot yet be assessed.

The Ministry of Industry, and bodies such as ACARD (Advisory Council on Applied Research and Development) and the Technology Group have been important instruments of public industrial policy. The Alvey Committee is now the main body responsible for encouraging co-ordinating and supporting fundamental research (directed towards fifth generation computing) and it thus provides the main strategic guidelines for long-term development. Its resources, £350 million, amount largely to a reallocation of existing commitments.[2/] But its purpose is to avoid fragmentation of effort and it has defined four key areas of research: semiconductor technology, man-machine interfaces, software engineering, and intelligent knowledge-based systems. It is intended that £95 million of the total funds for the five-year period will go to VLSI projects.[3/]

The United Kingdom is now Europe's biggest user of chips, although national producers have only 2 per cent of the world market. Nevertheless it has a significant company, Ferranti, in the increasingly important field of gate arrays. The latest government initiative in

---

1/European Trade Union Institute "European Industrial Policy for the Electronics and Information Technology Sector", Brussels, September 1984.

2/"Computer Weekly", 1 March 1984.

3/The Economist, 17-23 November 1984.

microelectronics is the Misp-2 programme, £120 million over the period 1984 to 1990. It will include strategic understandings with industrial companies and give high emphasis to gallium arsenide technology, chip making equipment, and gate arrays.[1/]

3.7 Spain

Spain is the latest (in March 1984) country in Europe to release a detailed government plan in electronics and informatics. Due to its intermediate level of development it is of interest to review briefly the main objectives. The programme covers the period up to 1987 and has four basic objectives:

- To increase considerably the demand and consumption of electronic and informatic products with special emphasis on those which have the greatest multiplier effect on the rest of the economy.
- To increase substantially national production in order to supply the national market with a growing number of locally produced goods.
- To increase exports very rapidly although this implies that imports cannot be substantially restricted.
- To decrease progressively the level of technological dependence by developing national capabilities.

In quantitative terms the programme has ambitious goals:

- To increase apparent consumption from Ptas 439,000 million in 1982, to Ptas. 728,000 million in 1987. This means an annual cumulative increase of over 10 per cent in constant prices.

1/ "The Guardian", 20 March 1984.

- To increase national production of equipment and systems from Ptas. 227,000 million in 1982 to Ptas. 545,000 million in 1987. This would be an annual cumulative growth of nearly 20 per cent.

- To increase exports from Ptas. 55,000 million in 1982 to Ptas. 229,000 million in 1987. This would be an annual cumulative growth of over 33 per cent.

The programme outlines specific measures in consumer electronics, components, telecommunications, informatics, defence, industrial and medical electronics.

The general measures can be grouped into five areas: financial incentives, public procurement, standardization, development of national technological capacity, and links with foreign companies and centres of excellence.

The financial measures include special loans, tax incentives and tax deductions for venture capital investments. In addition, there will be special provisions for Spanish companies who wish to participate in the equity of foreign companies. This measure, unique to current programmes, acknowledges the fact that the process of transfer of technology in electronics has changed and that in some cases access is only possible through part ownership. Futhermore, the most important thing is to be part of the process of technological change rather than simply passively obtaining licenses.

The rationalization of public procurement and the standardization of the equipment to be acquired by the public sector are high priorities in the programme. Measures in this respect, as well as those for the development of national technological capabilities, are not different from many programmes that exist in other countries. Nevertheless, the initial emphasis is on ensuring diffusion and participation of small and medium-sized enterprises.

In terms of policy for foreign investment and links, the attitude is to seek actively participation of international companies with emphasis on exports and technology. In the case of ICs, for instance, the production of standard circuits is left to well-established, foreign producers (an agreement has already been signed with AT&T to the value of US $200 million in investment) while national companies will be developed for custom and semi-custom circuits. The component programme puts great emphasis on developing national capabilities in circuit design.

In all sectors, the policy includes traditional mechanisms of import substitution such as tariff barriers. At the same time, national industry is encouraged to achieve international standards in an attempt to avoid creating an obsolete industry. This can be a risk when static import substitution policies are used. By obliging companies to export they become de facto subject to international competition. Tariffs and regulations will inevitably decrease as Spain enters the EEC.

The plan is now being complemented with special measures in other fields such as education, and the creation of a network of technology centres throughout the country in order to ensure diffusion and application. Special measures are also being negotiated with other industrial sectors such as automobiles, machine tools and producers of electrical equipment in order to involve them in the plan of creating a wider market for the domestic industry.

3.8 European Economic Community

The major initiative within the Community, as distinct from the national programmes of its member states such as those described above for France, Federal Republic of Germany and the United Kingdom, has been the ESPRIT programme (European Strategic Programme for Research and Development in Information Technologies). This programme reflects its title in that it is strategic in nature: its objective is explicitly to retrieve and increase the competitiveness of Community industry by research in key areas.

The perceptions of the EEC Commission with respect to the field of informatics are quite explicitly stated. The industry is expected to grow at between 8 and 10 per cent worldwide, and it is one which already directly contributes 6 per cent of Community GDP (in the form of computers, software and components), with a further 29 per cent if telecommunications, office automation, consumer goods, factory automation, defence, and heavily information dependent financial institutions are taken into account. The EEC is seen as becoming rapidly more dependent on imports, having moved from a surplus in 1975 to an estimated deficit of 10 billion ECU in 1982. In fact, this deficit is worse because the imports are more technologically advanced than the exports. The EEC is seen as suffering from technological lags and dependence, with long-term R&D having been neglected in favour of short-term.

In general, information technology is recognized for its capacity to transform both the production structure and society itself. But equally recognized are the other actors in this field: "... indigenous capabilities will have to be acquired in key areas in order to be able to compete, and also to co-operate, with the United States and Japan on equal terms."1/

What is planned is a programme of research which will be "pre-competitive" and "generic", thus intended to provide advances which can then be made use of by community enterprises at the stage of commercial exploitation. The EEC will fund, in general, 50 per cent of each research project within the programme. The criteria for funding include the technical soundness of the research, the extent of the contribution to the overall objectives, the degree to which it has a Community-wide dimension, the capacity of the proposers to carry out the research and the accessibility of the results. For the larger projects there is a specific requirement that at least two distinct companies in different member countries be involved.

1/ (Official Journal of the European Committee, C321 Vol.26, p.6, 26 November 1983.

The areas of action are the following:

a) Advanced microelectronics, with specific goals in chip size and integrated circuits;

b) Software technologies, including theories and methods, software engineering and the economics of software;

c) Advanced information processing, including artificial intelligence, knowledge based systems, signal processing, and system architecture;

d) Office systems (estimated to be the largest single informatics market);

e) Computer integrated manufacturing (CIM) (for which a 39 billion ECU world market by 1990 is estimated);

f) Infrastructure: the improvement of the exchange of findings and information.

The ESPRIT programme is intended to be a ten-year one, but its first stage is for five years, and total EEC spending during this period is to be 750 million ECU, with the whole value of the programme being 1,500 million ECU. But, as has been pointed out,[1/] this is a lot less than the annual budget of IBM alone for research and development. As against that, however, the national and private R&D expenditure outside the ESPRIT programme must also be taken into account.

The Economic and Social Committee of the EEC, giving its opinion on the ESPRIT programme, recognized the dimensions of the problem facing the informatics industry in the EEC and gave its support to the programme. It pointed out the need for co-ordination with national programmes which as has been seen are extensive. It also referred to potential difficulties if EEC subsidiaries of outside firms were to be able to make use of ESPRIT results. However, IBM and ITT are already expected to participate.[2/] Finally it should be noted that the Commission also has plans in the field of telecommunications, which are described in section 5.4.

1/ Computer Weekly, 1 March 1984.

2/ Computer Weekly, 11 October 1984.

3.9 Conclusions

Public policy programmes also exist, in different stages of implementation, in Italy, the Netherlands, Sweden, Norway, Austria, Canada and Australia. Italy has strong companies in the fields of computing and telecommunications (and the new links between Olivetti and AT&T are interesting from this point of view). Philips in the Netherlands is the second largest microchip supplier on the European market, and has now entered into co-operation with Siemens of the Federal Republic of Germany to develop and manufacture advanced memories (1 megabit and 4 megabit RAMs) by 1989. The plan is backed by the respective governments and may cost a total of US $1 billion.[1/]

Although one could describe in further detail all aspects of public policy in advanced countries, what is important to bear in mind is that national goals are pursued in advanced technologies because neither public nor private companies can do it alone. The aim of public technology and industrial policy is essentially one where the state either takes the risk, shares risks or encourages companies, by a battery of measures ranging from direct support to tax incentives, to take risks. From the point of view of international trade there are no rules that regulate the areas of public industrial or technological policy. This is often seen as a form of neo-protectionism. This aspect is dicussed further in Chapter 5.

1/Financial Times, 11 October 1984.

Chapter 4
GOVERNMENT POLICIES IN DEVELOPING COUNTRIES

The situation among developing countries varies considerably. There are those which used to have a substantial electronic industry and, essentially due to lack of supportive public policy, opportunities to develop it further have been missed. Another group of countries, notably the Republic of Korea, Singapore, Taiwan Province and the territory of Hong Kong are important exporters of electronics and have been able to penetrate the markets of advanced countries. In these cases, public policy aims at encouraging exports, and their industries are normally heavily dependent on foreign capital.

A third group is constituted by those countries with a large internal market and an explicit policy in the electronic sector, such as India and Brazil.

This heterogeneity precludes generalisations. It is only possible to say that either an export or an import-substitution oriented strategy is followed under some form of public sector policy, guidance and support.

4.1 Far East

Far East producers dominate developing countries manufactured exports in electrical goods. The territory of Hong Kong, together with Taiwan Province, the Republic of Korea and Singapore, accounts for about 80 per cent of total electrical goods exported from developing to developed countries, despite the rapid growth of Malaysia, Thailand and Indonesia.

A better perspective of this growth is obtained by comparison with other developing countries over the years. In 1967, India exported about the same value as the Republic of Korea but only about one-tenth a decade later. Argentina exported more than Malaysia in 1967 and less than one-tenth a decade later. The difference of performance is also related to type of products. Far East NICs specialized in components and consumer electronics, whereas others had more varied exports with a large portion of electromechanical equipment. An additional and crucial difference, partly related to the products' characteristics, is the type of ownership of the industry with a strong presence of foreign capital in Hong Kong, Taiwan Province, the Republic of Korea, and Singapore. These showed the fastest growth in the 1970s. In the last two countries, almost 100 per cent of electrical goods exports were made by locally based foreign companies, particularly for assembling of components.

Hong Kong has less penetration of foreign electrical and electronic multinationals but their weight is disproportionate. They accounted for 70 per cent of all foreign investment in the 1970s. A survey in 1979 showed that although only 67 out of 768 registered electronics companies were wholly or partly foreign-owned, they nevertheless accounted for 41 per cent of the labour force employed.

In the Republic of Korea, foreign multinationals accounts for only 15 per cent of total manufactured exports but 75 per cent of electronics exports. In Taiwan Province, 48 per cent of all foreign investment in the last 25 years has been in the "electronics and electrical appliances" sector.

The informatics industry in Korea is certainly considered strategic and is emphasized in the fifth five year plan (1982-1986) in contrast to the fourth, where heavy industry was emphasized. In addition the detailed role of individual ministries is noteworthy. The Ministry of Commerce and Industry has prepared long-term promotion plans for the semiconductor industry (1982), the electronics industry (1983) and the computer industry (1984). The Ministry of Science and Technology is responsible for the Korean Advanced Institute of Science and Technology (KAIST) and important laboratories in the electronics field. R&D funding was 1.09 per cent of GNP in 1982 and is planned to be 2.0 per cent in 1986. A comprehensive network of collaborative agreements now links the major Korean private companies with ITT, AT&T, Toshiba, and Northern Telecom in the field of microelectronics with a similar network in the field of telecommunications.[1/]

[1/] A detailed analysis of the situation in the Republic of Korea can be found in "State-of-the-Art Series on Microelectronics No.3: Republic of Korea", UNIDO/IS.490.

It should be noted that these countries, which have encouraged foreign investment as an explicit development strategy, have also begun to complement this policy in order to maintain competitiveness.

From the point of view of public policy, what is of interest here, besides the well-known encouragement of foreign investment, are the current adjustments to rapid technological change. The level and mechanisms of public sector intervention varies from country to country but the search for greater technological autonomy is evident in all of them. This is essential to increasingly sophisticated, high value-added products. This can clearly be seen, for instance in the field of components where the Government of the Republic of Korea has installed ICs capabilities with a US $140 million loan from the World Bank. Integrated circuits capacity, beyond encapsulation of chips, for consumer products is being developed in Taiwan and Hong Kong. Singapore has encouraged further foreign investment, while rapidly upgrading its labour force, through systematic government programmes. At this stage, Singapore's main attraction for investment is not labour cost but the fact that the infrastructure is very sophisticated. In Taiwan, generous inventives are given to companies to establish themselves in the "technology parks". Underlying these developments is the emergence ot large local companies which are licensing technology extensively. Despite progress, these industries lag behind industrial leaders and the gap might be growing. V. Cable and J. Clarke, commenting on the developments of these producers, stated:

> "(in South Korea) R&D expenditure is measured at 1.3 per cent of sales revenues, a third of Japanese levels. Nor are all the modernizing objectives necessarily consistent. New generations of products require new components, making obsolescent those painfully developed locally. New products also require international commercial alliances which could weaken the independent capacity of local firms."1/

1/Cable, V., and Clarke, J. "British Electronics and Competition from Newly Industrializing Countries" ODI, London 1981, p.40.

Their conclusion is, however, that "these countries have little choice but to press on".

For developing countries, the strategy followed by these producers might no longer be applicable, except in very restricted cases. In fact, the late-comers, such as Malaysia, Thailand and the Philippines, have not been able to approach even the early performance of Hong Kong, Taiwan Province, Republic of Korea and Singapore.

Another group of countries is of those with a large internal market which, through time, developed a policy in the field of electronics or are in the process of doing so (e.g. Mexico). Two cases will be reviewed briefly here, those of India and Brazil. Neighbouring countries where development is at an earlier stage are also the subject of UNIDO surveys in the State-of-the-Art series on Microelectronics.[1/]

4.2 India

Computerization started in India in 1955, with the installation of first-generation machine by the Indian Statistical Institute. The next nine years saw the installation of sixteen more computers in the country. This was followed by the second phase of computerization which started in 1965 and lasted until 1972. During this phase, the rate of computerization was much faster as organizations in private and public sectors, government and educational institutions acquired computers in increasing numbers. From 1973 onwards, the process of computerization seems to have entered a third phase marked by an emphasis on increased power and better utilization. During this period, IBM pulled out of India, giving rise to several, now successful, companies in the field of computers. Many will argue that the departure of IBM was the single most important factor influencing the development of domestic capabilities. Local companies were obliged to take over software development, service and maintenance.

[1/] These are Venezuela (UNIDO/IS.489), Pakistan (UNIDO/IS.493) and Bangladesh (UNIDO/IS.497). See also "Overview of the Microelectronics Industry in Selected Developing Countries" (UNIDO/IS.500).

All policy issues involving the field of electronics come under the Electronics Commission of the Department of Electronics in the Government of India. The importance of this department is highlighted by the fact that this portfolio is normally always held by the Prime Minister.

A basic policy for encouraging electronic development was contained in the 1978-83 Electronics Plan. Within this plan, it is the report of the Subgroup on Computers that forms the cornerstone of government policy in this area. The report attaches high priority to the area of computers in the planning and promotional scheme of the Electronics Commission. The Plan states:

> "... the strategy for the development of this important industry should be based on national needs and priorities, indigenous development and import of technology. Electronics Commission has evolved a plan comprising the development of indigenous technology in some areas and acquisition of technology from abroad in other areas on a selective basis, building up a broad-based structure of industrial capacity, utilising both indigenous and imported streams of technology, manpower training, education of a wide range of computer users on the optimal way in which their computing needs can be met, setting up large regional and national computer centres."

This strategy has been implemented, using a number of policy and executive instruments, ranging from high tariff barriers, monitoring and promotional measures of industrial import licencing, R&D contracts to public sector companies, laboratories and research institutes, and the establishment of computer facilities in different regions of the country.

The total number of computers in India is difficult to assess. There is a large number of microprocessor-based systems that are locally produced. Thirty companies are now solely engaged in computer and microcomputer manufacturing. It is, however, important to note that most of the components and peripherals for these machines continue to be imported. However India has capacities (if not yet fully realized) in several inputs to microelectornics production, such as chemicals, gases and dopants.[1/] Software capability has developed within the country in response to local demand but is now increasingly directed at the export market. The growth rates of the industry are shown in Table 8.

In Table 9, the 1982-83 figures for electronics exports from India indicate significant growth during the year. Exports rose from Rs. 564 million in the previous year to Rs. 890 million. This increase is largely due to the share of Santacruz Electronics Export Processing Zone (SEEPZ) and computer software. The export of computer software accounts for 11.5 per cent of the total exports made during 1982 which indicates its increasing importance. The largest category of exports from India in the field of electronics continues to be aerospace and defence equipment which recorded a growth rate of 38 per cent followed by electronic components which went up by 20 per cent. Electronics exports from SEEPZ increased significantly during 1982, recording a growth of 89 per cent over their value in 1981.

Table 8: Growth rates of the Indian electronic industry - 1982

Sector	Growth rate (percentage)
Consumer electronics	37.0
Communication and broadcasting equipment	65.5
Aerospace and defence equipment	57.2
Computers	68.4
Control, industrial electronics and instrumentation	20.4
Components	23.7

Source: Annual Report of the Department of Electronics 1982-1983, Government of India, New Delhi, 1983, p.4.

[1/] See "State-of-the-Art Series on Microelectronics No.2: India (UNIDO/IS.492). This paper gives a detailed account of microelectronics and associated fields in India, including government policy in this respect.

In absolute terms, exports from SEEPZ increased from US $25.5 million to US $48.5 million. A major portion of the exports from the zone are in high technology areas and have been made to advanced countries.

Significantly, the share of Eastern Europe and South America has been negligible in electronic exports from India. The largest share of these exports is held by Asia, followed by North America and Western Europe.

Table 9: Electronics exports of India, 1980-1982 (in millions of US dollars)a/

Sector	1980	1981	1982
Consumer electronics	4.22	4.00	4.10
Computers, control and instrumentation	2.88	3.00	1.60
Aerospace and defence	4.95	9.55	13.20
Communications	3.51	1.95	1.70
Components	6.76	8.00	9.60
Computer software	3.00	4.40	10.30
SEEPZb/	16.49	25.50	48.50
Foreign exchange remitted through technical servicesc/	-	-	5.40
Total	41.81	56.40	89.00

Source: Government of India, Annual Report of the Department of Electronics, 1982-83, New Delhi, 1983., Annexure-II.

a/ (10 Rupees = $1)

b/ Santacruz Electronic Export Processing Zone

c/ The value is not included in the total as the item is being included for the first time.

In the area of computer software exports, the rates of growth are not only impressive but also exhibit a steady and increasingly growing trend. This is largely due to the export oriented policies followed by the Government of India. The expansion in volume of exports has accompanied market diversification. The USSR, the United States and Belgium are the regular markets showing steady growth. These countries together account for about 60 per cent of the computer software exports. Electronics are not only receiving attention from the Central Government but also from the state level Electronics Development Corporations which play a key role.

The 1978-83 plan recognises the existence of a huge software export potential which is, as yet, not fully exploited. The Plan recommends setting up general infrastructural facilities such as standardization and testing, Export Quality Assurance Centres, and National and Regional Computer Centres.

It is worth noting that the Plan was formulated in 1978 and considerable progress has been made since then. A National Informatics Centre has started with aid from UNDP. A National Centre for Software Development and Computing Techniques has been set up, as well as several Regional Computer Centres.

To achieve the overall aims of the planners, the Department of Electronics has adopted the following approach:

1) It has set up a Technology Development Council to identify priority areas, to assess the capability of various organizations engaged in R&D in the field of electronics, and to finance projects to overcome technology gaps.

2) In April 1980, the Department of Electronics set up an Expert Committee to review the existing software programmes and strengthen the export effort to make it more effective. The Report of the Committee has since been considered by the Electronics Commission and a revised policy and set of procedures have been approved by

the Central Government for promoting computer software exports. Facilitating computer hardware imports is one of the most significant changes in policy.

The policy in India has been based on a large potential market and on the assumption that state of the art technology is only required in very selected areas, especially those relating to exports. The liberalization of procedures and licencing of computers that has taken place in the last three years is related precisely to export areas, whether for software or for manufacturing companies that require state of the art equipment.

Two examples illustrate some of these points. India's state-owned Semiconductor Complex Ltd., based in Chandigarh, is considering setting up a design centre in Silicon Valley in California as a means of training its own designers in state of the art technology,[1/] and twelve foreign software companies are now established or plan to be so in the Santa Cruz Electronics Export Processing Zone (SEEPZ) in Bombay.[2/]

In essence, the Indian policy has been based on the traditional import substitution strategy, complemented by selected imports of equipment licensed on a case-by-case basis, and the development of an export processing zone aiming at generating exports and capturing technology. The presence of this zone, as is also the case of the free zone area in Manahus in Brazil, somewhat contradicts the domestic policy, essentially because it discourages internal production of items such as components.

1/ Electronics, 31 May 1984.

2/ UNIDO Microelectronics Monitor No.9, January-March 1984.

4.3 Brazil

Brazilian efforts in the field of information technology can be traced back to the creation, in February 1972, of a special task force (GTE), formed by the Government through the Ministries of the Navy and Planning, with the financial support of the National Development Bank and the financial agency, FINEP. The task force conceived the project Guaranys, which consisted basically of building microcomputers (G-10), with hardware developed by the University of Sao Paulo and software provided by the Catholic University of Rio de Janeiro.

At the same time, this group proposed the creation of an instrument of state intervention to encourage and participate in the development of eelctronics. A company (Electronica Digital Brasileira Ltd.) was formed in 1973. In 1974, it became a public company named Digibras, S.A. The stock of this company is owned by state companies directly or indirectly linked to the Federal Government, and they comprise an important part of the current and potential market of computer and data processing equipment.

In 1972, upon the recommendation of the task force, CAPRE (Co-ordination Commission for Data Processing Activities) was created with the specific mandate of improving and providing orientation in the use of data processing equipment for public administration. In practice, CAPRE's functions evolved into regulating the computer market and supervising developments in the data processing field. Its strategy became the basic core of current Brazilian policies in the informatics area.

In 1979, CAPRE was superseded by SEI (Special Secretariat of Informatics). Institutionally, SEI is part of the organization of the National Security Council of the Presidency. This in itself shows the high level of priority given to the electronics sector. SEI is responsible for the entire informatics policy, including import licences but excluding the field of telecommunications which comes under the appropriate ministry. Co-ordination exists but the Ministry can implement policy autonomously. This is different from some developed countries (i.e., Federal Republic of Germany, France and Japan) where telecommunications are part of informatics and technology policies.

The first important development of Brazil's informatics policy took place in 1975 when provision was made for prior authorization by CAPRE for the import of computers, accessories, parts and components. This was partly triggered by the deterioration of the balance of payments situation after the oil crisis but, as a government document explains, the intention was broader:

> "The Government was convinced that informatics was strategically important to the nation and that, therefore, Brazil needed a policy which would enable it to acquire the technical capability necessary to reduce its dependence."1/

In order to reduce the country's dependence on foreign technology, CAPRE in 1976 defined five objectives:

- To obtain the technological capacity that would enable electronic equipment and software to be designed, developed and produced in Brazil.
- To ensure that national corporations play a predominant role in the national informatics market.
- To obtain a favourable balance of payments in products and services related to informatics.
- To create jobs for Brazilians and more professional employment opportunities for Brazilian engineers and technicians.
- To create the opportunity for the development of a Brazilian parts-and-components industry in informatics.

1/UNCTC "Transborder Data Flows and Brazil", New York, 1983, p.63.

The guiding objectives were subsequently extended to include a further four:

- To maximize the amount of information resources located in Brazil, including computer power, software, data bases, technical and managerial skills, as well as control of switching and routing systems (whether the hardware is imported or not).

- National control of production of information resources.

- Universal access to information.

- Information as a resource to enhance national cultural and political life in order to reinforce identity and sovereignty.

In order to fulfil the original set of general objectives, a policy in the hardware field was established. It contained three basic measures:

1) Import controls, not only with the objectives of correcting the balance of payments disequilibrium but also to protect the emerging industry.

2) The creation of a national computer firm, Computadores Brasileiros S.A. (COBRA), with 61 per cent government equity and the remaining 39 per cent subscribed by the 13 largest Brazilian private banks.

3) The adoption of a protective scheme reserving the emerging market for micro- and mini-computers, as well as peripheral equipment, for the benefit of national corporations, and local technology. In the framework of this scheme, national corporations were granted permission to acquire foreign technology, parts, accessories and components under a progressive product-nationalization plan while constituting themselves as data-processing equipment manufactures.

The intention here is not to evaluate the details of policy. It is important to see that it has achieved some rapid results in a rather short period of time. An industry has been created within a period of a few years, as can be seen in Table 10.

Table 10: Imports as percentage of total company revenues

	1979	1980	1981	1982
National companies	28	20	8	7.5
Multinationals	28	36	40	n.a.

Source: Special Secretariat of Informatics, 1983.

Further signs of rapid development of the industry are seen in export performance. According to a survey undertaken by Digibras, total exports of computers, in 1982, were only US $147,000 but, in 1983, they reached US $26 million. This enormous increase is partly due to the fact that, in 1982, only four Brazilian companies were exporting while, in 1983, the number has risen to ten. It might also be a sign that at least some sectors of the industry are succeeding in lowering costs compared to international standards. The biggest market for Brazil is Argentina with 46 per cent of total exports, followed by the rest of Latin America. The national industry is making a considerable effort in the technology field and putting great emphasis on R&D. Although figures are not available in terms of expenditure, they exist for use of personnel. These show a sharp contrast with foreign companies (who tend to import technology) and this fact may partly explain the growth in their imports of parts and components. The differences are shown in Table 11.

Specific measures to encourage the industry were pursued in seven main areas, namely: import control of finished products; imports of parts and components; government procurement policies; perefential treatment to domestic alternatives of real-time control systems; technology transfer; R&D, and microelectronic components.

Table 11: Number of professionals of high level by function, 1981

	National industry	Multinationals
Production	279	396
Sales	312	1,077
Development - software	429	44
Development - hardware	402	53
Maintenance - hardware	199	193
Administration	453	791
Total	2,074	2,554

Source: Special Secretariat of Informatics, 1983.

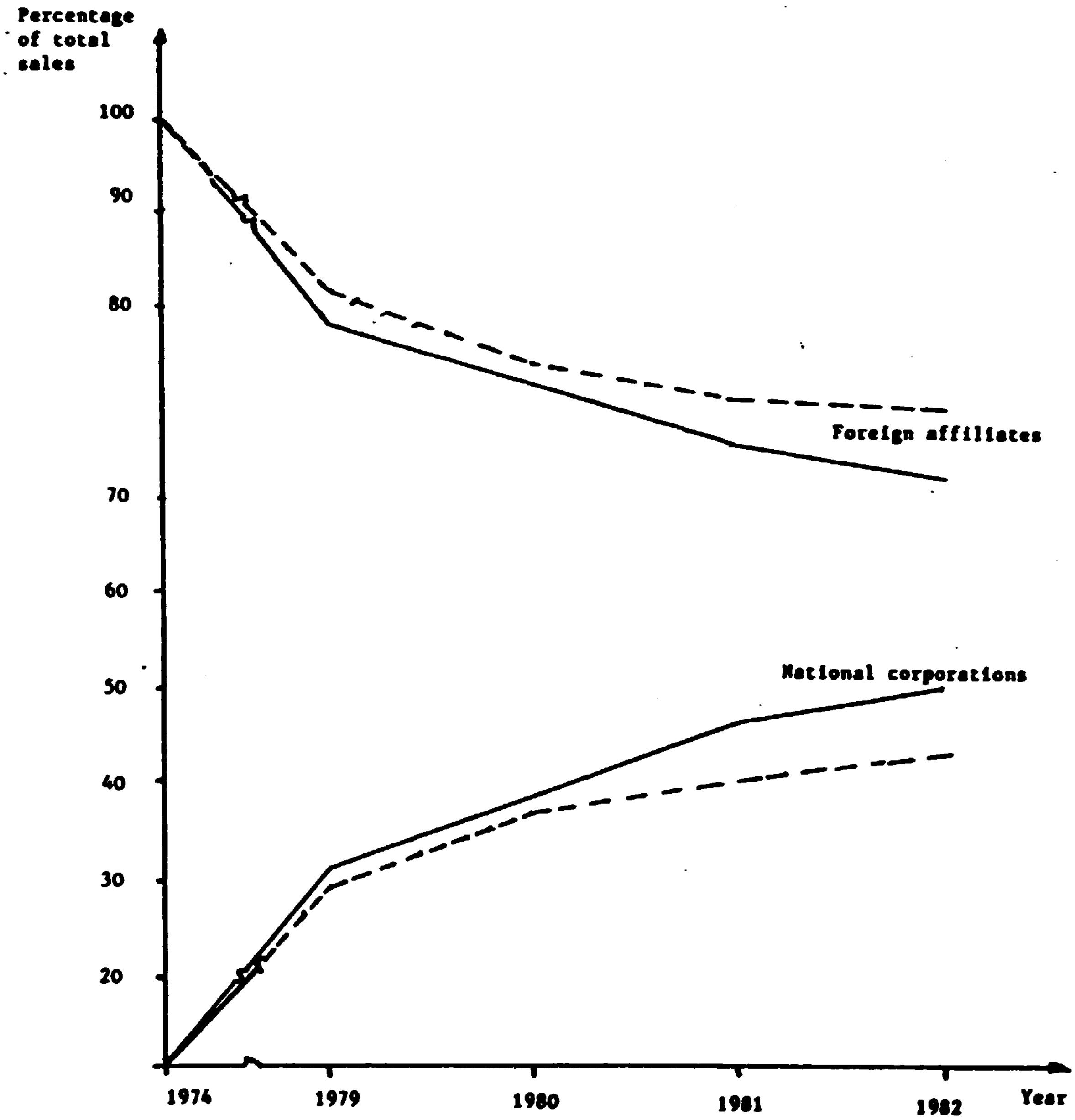
In the field of microelectronic components, digital circuits have been reserved for national companies and two of them have been pre-selected by the Government. The Informatics Technology Centre has been established to develop a manufacturing facility to design integrated circuits and act as a bridge between industry and universities.

Table 12: Sales of national and foreign companies in the telecommunications industries, 1978-80

Year	National Companies: Small and Medium size	National Companies: Large	Sub-total	Foreign Affiliates	Total
1978	10	-	10	90	100
1979	7	39	46	54	200
1980	34	25	59	41	100

Source: Estimates of the technical staff of the Special Secretariat of Informatics in UNCTC, "Transborder Data Flows and Brazil", New York, 1983, p.51.

Figure 1: Shares of national and foreign affiliates in data-equipment sales, 1974-1982



Key:
—— Share in domestic sales
- - - - Share in doemstic and export sales

Source: UNCTC, Transborder Data Flows and Brazil, New York, p.85.

Brazil has some precedents in the field of information technology in terms of substantial achievements of industrial policy. This is the case of telecommunications, particularly after 1978, when specific directives for the industry were issued. The changes are reflected in, for instance, sales of national and foreign companies, as shown in Table 12.

In terms of imports of telecommunications equipment by Telebras, the value has been reduced from US $100 million in 1976, to US $19 million in 1981, or only 2 per cent of the total investment of Telebras at the end of this period. National technology in telecommunications has also made substantial progress with investment in R&D with Telebras increasing from US $26 million in 1977 to US $52 million in 1981.

In general, it can be said that Brazilian public policy has developed due to the consideration of informatics as a strategic sector as well as a balance of payments constraint. Although it is likely that the policy will be refined in the future, the thrust will remain the same. Brazil has just adopted legislation giving eight years full protection to domestic micro and mini computer producers. It also severely restricts new investment by TNCs. A proposed R&D research fund of 800 billion cruziros annually has, however, not yet been adopted.1/

1/ Financial Times, 31 October 1984.

Chapter 5

OBSTACLES TO TRADE IN INFORMATICS EQUIPMENT

5.1 Introduction

In 1982, world trade in telecommunications equipment and electronic products was about $80 billion. The role of developing countries was significant, with their exports to industrialized countries being over $11 billion in value. However, these exports came from only a few developing countries, with 85 per cent coming from East Asia. There was also diversity in the performance of developed regions. Only Japan has a surplus in all five groups: computers, consumer electronics, calculators, electronic components and telecommunications equipment. The United States had a surplus only in computers, and Western Europe only in telecommunications equipment, with deficits in their trade in the other groups of products.[1/]

It is true that trade in these categories is only a small part of total trade in manufactures. It amounted to only 6 per cent in 1980. But not only is it increasing in size, but it also has special importance because of its strategic characteristics. It reflects both technological change and the conscious policies, described above, of governments and private corporations. The trade takes place in an environment determined in part by conflicting and heterogenous national policies, and many of these policies have a discouraging effect on the growth of this trade.

The effects are as follows: trade takes place in the face of:

(a) Tariffs: tariffs, quotas, ceilings, etc.
(b) Non-tariff barriers and obstacles, including:
- quotas, ceilings
- government purchasing policies
- technical standards

1/GATT "International Trade 1982/83", Geneve, 1983.

- sectoral policies
- valuation principles

This note summarizes the position with respect to each of these. In general, however, information is incomplete and the non-tariff barriers are particularly difficult to quantify or to rank by importance.

5.2 Tariffs

The basic structures determining tariffs are given, in general, by two sets of rules:

a) the Tokyo Round of GATT
b) the Generalized System of Preferences

The Tokyo Round was a series of multilateral trade negotiations carried out from 1973 to 1979. A total of 99 countries participated, of which 29 were not contracting parties or acceded provisionally to GATT. Economically important countries not participating include the USSR, China, German Democratic Republic, among others. The results can be regarded as of two kinds: tariff reductions and a series of agreements affecting other issues in trade, such as subsidies and countervailing duties, technical barriers, customs valuation, government procurement, etc. But agreements were not by any means universal: the reductions in tariffs were not uniform across products and countries, nor did all countries accept the agreements on non-tariff barriers. An element of universality was however preserved in the "most favoured nation (MFN)" principle, that when a country adopted a new tariff, it did so with respect to imports from all countries.

Even this is subject to variation, as the case of semiconductors shows. The highest tariff among industrial market economies is that of the EEC at 17 per cent, with the United States at 6 per cent[1/] and

---

1/ Dosi, G. "Semiconductors: Europe's precarious survival in high technology' in Shepherd, G. et al (eds.) "Europe's Industries", Francis Pinter (Publishers) Ltd., London 1983.

Japan at 12 per cent. This latter figure is intended to reduce to the Tokyo round target of 4.2 per cent in 1988.[1/] But Japan and the United States concluded a bilateral agreement to reduce tariffs on semiconductors to 4.2 per cent from 1982. There are indications that Japanese producers are now restricting their exports to the United States to avoid tensions.[2/]

A shortage of some electronics products has led to a recent relaxation of the external tariffs of the EEC.[3/] Council regulation (EEC) No.1410/84 of 15 May 1984 temporarily suspended duties on a number of products whose production was 'inadequate or non-existent' within the community and where producers were unable to meet the needs of user industries. For the second half of 1984, zero tariff rates were to apply to a wide range of components using NMOS, CMOS and HMOS technology, bubble memories, EPROMS, PROMS, EEPROMS, gate arrays, digital displays etc. Rates varying from 4 to 11.5 per cent are applied to static RAMS, field programmable array logics, and NMOS programmable communication interfaces and interval timers. But these relaxations are explicitly temporary and higher tariffs would presumably reappear if EEC production capacity improves.

The actual structure of tariffs especially between developed countries, remains a complex one even though the Tokyo Round certainly brought about reductions in them. As far as developing countries are concerned, their exports to most developed market economies are largely governed by the Generalized System of Preferences (GSP).

1/ Kikkada, M. "Shipbuilding, Motor Cars and Semiconductors: the diminishing role of industrial policy in Japan". Loc. cit.

2/ Anjaria, S.J., et al "Developments in International Trade Policy" IMF occasional Paper No.16, Revised July 1983.

3/ Official Journal of the European Communities, L 141, Volume 27, 28 May 1984.

The GSP means that many developed countries allow access to imports from developing countries at tariff rates lower than those normally applied. Each developed country has its own scheme and its own rates. The scheme often incorporates quotas (a limit on the imports from any one developing country) and ceilings (a limit on the total amount of imports) which restrict the benefits. The consequence of these and other factors such as documentation requirements can be that not all the potential benefits are realized. Overall, imports "covered" by the system have regularly exceeded imports actually given GSP treatment by a factor of more than two.[1/]

The operation of GSP schemes with respect to informatics equipment from developing countries is therefore not easy to summarize. The following is an impressionistic attempt based on detailed information supplied by UNCTAD. It must not be regarded as a final statement: as noted above quotas and ceilings may apply and, in addition, specific commodities within a product group may face a quite different (usually higher) tariff than the most frequent tariff value for the group. The summary therefore is intended only to convey a general picture of GSP tariffs:

Australia — Zero rates on calculating machines and computers, 10 per cent on CRT terminals. Zero rates on most telephone and telegraph equipment. For measuring equipment, there is a 20 per cent tariff on oscilloscopes and the like, and rates between 18 per cent and zero on other measuring equipment.

Austria — There is a wide range of different tariffs, but none of them are very high (zero to 4 per cent or so) except for radio and television receivers, which are 19 per cent and 17.5 per cent, respectively (half the normal rate).

1/ OECD "The Generalized System of Preferences: Reviews of the First Decade" Report by the Secretary General. Paris 1983.

Canada	Zero rates on semiconductors and parts thereof. The situation with respect to other groups is more complicated. Thus a zero rate applies to telegraph apparatus and a 10 per cent rate to telephone apparatus. In the computer field tariffs of zero and 2.5 per cent are noted with 11.5 per cent for some apparatus and 8 per cent for EDP tape recording devices.
Finland	Zero rates for the calculator, telephone, telegraph, microcircuits and computing fields, but normal MFN rates for radiotelephone, TV and other equipment (which are often 21 per cent).
EEC	Zero rates in all important categories, but quotas in many.
Japan	Zero rates in all categories, with quotas in some integrated circuits categories.
New Zealand	Limited concessions, both in GSP and MFN. Tariffs in general high. Zero rates on semiconductors and micro-circuits.
Norway	Zero rates.
Sweden	Zero rates.
Switzerland	Zero rates.
United States of America	Zero rates. Quotas in some categories.

As noted, the GSP tariffs are non-reciprocal, and thus while they apply to the products of developing countries, these countries are not obliged to maintain similar tariffs for their own imports. It should also be noted that the GSP tariffs are concessionary: at the times of the GATT agreement the principle was introduced of "graduation", opening up the possibility that as developing countries progressed, they would be expected to lose preferential treatment.

As for developing country tariffs, the position is rather different. In general the tariffs appear higher, but the reason behind this is usually to protect the balance of payments rather than any domestic industry. There are of course exceptions. Table 13 gives a summary overview of tariffs (customs duties and others, when appropriate) for a large number of developing countries for three specific commodities in the informatics field. The figures in the table are indicative only, as a more detailed interpretation would be needed in individual cases. In no case have production, consumption, sales and turnover taxes and the like been included, since in general these would be applicable to domestic goods as well as imports. However, they are sometimes considerable and in certain circumstances are also regarded as obstacles to trade depending on the way in which they are applied in practice.

5.3 Other quantitative measures

Some developing countries have reported specific trade measures affecting their exports in the fields in question. Thus the Republic of Korea reported a global quota on semiconductors introduced by France in 1978, and Malaysia reported import licensing and tariff quotas being applied by the EEC to semiconductors, microcircuits and telecommunications equipment. Several ECLAC region countries (Brazil, El Salvador, Haiti) have faced a combination of tariffs and ceilings for their exports of diodes to the EEC.[1/]

[1/] Von Gleich, A. et al "The Political and Economic Relations between Europe and Latin America in view of the Southern Enlargement of the European Community due to the Entry of Spain and Portugal" Institute für Iberoamerika-Kunde, Hamburg, June 1983.

Table 13: Customs duties and other tariffs on informatics equipment in selected developing countries (per cent)

Country	Telecommunications Line Apparatus (CCCN code 85.13A)	Computers (CCCN code 84.53B)	Electronic parts: microcircuits (CCCN code 85.21D)
Algeria	25.0	10.0	10.0
Bahamas	32.5	42.5	32.5
Bangladesh	35.0	100.0	100.0
Burundi a/	20.0	20.0	50.0
Caricom	10.0	25.0	25.0
CEUCA a/	40.0	45.0	50.0
Cyprus	16.0	24.0	16.0
Eastern Caribbean Common Market	30.0	20.0	30.0
Egypt	15.0	5.0	5.0
Ethiopia	0.0	0.0	35.0
Gambia	0.0	25.0	22.5
Ghana b/	65.0	65.0	65.0
Guinea a/	115.0	120.0	120.0
Haiti	16.0	20.0	30.0
Indonesia b/	20-30.0	30.0	50.0
Iran	20.0	15.0	25.0
Kenya	60.0	40.0	30.0
Korea, Republic of	10-20.0	20.0	30.0
Liberia b/	7.5	50.0	20.0
Libyan Arab Jamahiryia	20.0	25.0	15.0
India	100.0	60.0	100.0
Malaysia	0-25.0	25.0	0.0
Mauritania a/	53.0	51.0	74.0
Mauritius a/	80.0	80.0	50.0
Morocco	30-40.0	40.0	30.0
Niger a/ b/	9.5-14.5	12.5	29.5
Nigeria	0-50.0	40.0	10-50.0
Pakistan	100.0	40.0	100.0
Paraguay b/	36.5	30.5	27.5
Philippines	10-30.0	20.0	20.0
Rwanda a/	10.0	15.0	15.0
Saudi Arabia	3.0	0.0	3.0
Sierra Leone b/	24.0	69.0	39.0
Singapore	0.0	0.0	0.0
Somalia a/	30.0	10.0	30.0
Sri Lanka	35.0	35.0	7.5
Sudan	40.0	60.0	40.0
Tanzania	15.0	15.0	15.0
Thailand	5.0	25.0	5.0
Togo b/	23.0	28.0	43.0
Tunisia	26-140.0	26.0	15.0
Zaire a/	15.0	15.0	25.0
Zimbabwe	0.0	0.0	15.0

Notes: a/ Including fiscal duties b/ Including other taxes and duties

Source: Data from the UNCTAD Information System on Barriers to Trade Among Developing Countries.

Other possible measures include licences, which can be discretionary. The licence may be issued automatically, with the procedure being used for monitoring purposes. Even in this case however delays may result. Table 14 gives a summary overview of some non-tariff measures being applied by different countries to imports of goods in four broad categories of equipment. It is based on information supplied by UNCTAD[1/] and is intended only to give indications of the types and distribution of measures being used and applying to all countries. Thus, for instance, the more selective measures employed by some developed countries against other developed countries (anti-dumping measures, voluntary export retraint, etc.), where trade conflicts exist are not covered in the summary table. It should also be particularly noted that the column headings are intended to give a broad summary of the product groups in question, and the measures do not necessarily apply tc all products in the group.

It has been pointed out[2/] that tariffs hardly count any more as trade barriers in the industrialized countries: it is non-tariff barriers that are showing rapid increases in form and in scope. Apart from those mentioned above, the areas of government procurement, technical standards and valuation principles as well as the implicit barriers (since they amount, if nothing else, to domestic subsidies) caused by sectoral targeting seem particularly important in the informatics sector, and are examined below. These qualitative areas are covered by the specific agreements negotiated as part of the GATT Tokyo Round, but the application of these is by no means perfect.

The developing countries were not, in general parties to these agreements. Thus only eight have accepted the agreement on technical barriers to trade, and only one that on government procurement. The status is summarized in Table 15.

1/ UNCTAD Data Base on Government Trade Measures of a Product-Specific Nature.

2/ Lütkenhorst, W. 'GATT - Caught between self-destruction and reform", Intereconomics, July-August 1984.

Table 14: Overview of some non-tariff measures affecting trade in informatics

	Calculators, accounting machines, etc.	Computers, etc.	Telephone and telegraph equipment	Electrical measuring instruments
Argentina	L	L	L	L
Brazil	P		P	
Colombia	L	L	L	L
Israel	L		L	L
Italy			L	
Kenya	Q	Q	Q	Q
Korea, Republic of	A	A	A	A
Mexico		L		
Pakistan	P		P	A, L
Peru			O	
Portugal			C	
Tunisia	A	A	L	A
Turkey	L	L		L
United Kingdom				L
Venezuela			P	M

Source: Based on data supplied by UNCTAD[1/]

Notes: 1. The symbols are

A : Authorization
L : Licence
M : State monopoly of imports
O : Other measures
P : Prohibition (sometimes with exceptions)
Q : Quota

2. Only measures affecting all countries are included.

3. Measures do not necessarily apply to all goods in each category.

[1/] UNCTAD Data Base on Government Trade Measures of a Product-Specific Nature.

5.4 Government purchasing policies

Government procurement has wide significance for trade in informatics equipment and the issues are very contentious. They include the role of PTTs (postal and telecommunications authorities), performance requirements (which can be linked with national sectoral targeting) and defence expenditure.

In the developed market economies, there is often a state monopoly in postal and telecommunications services, run by the PTT, and these bodies have up to now relied on their national manufacturers, even though privately owned, for the supply of equipment, with the PTT in the Federal Republic of Germany using Siemens, the Netherlands Phillips, Sweden L.M. Ericsson, Japan NEC, the United Kindom GEC and Plessey, and France CGE and Thomson- Brandt. In the United States AT & T has produced most of its equipment through its subsidiary Western Electric.[1/] However, the United Kingdom has taken steps towards de-regulation and privatization, and other countries (Canada, Ireland) are separating activities from direct civil service control, with, in Canada's case, denationalization plans. Australia is also examining deregulation of telecommunications, and AT&T in the United States has been compelled to divide into a number of competitive companies.[2/]

The GATT Tokyo Round included an important agreement on government purchasing behaviour (procurement). It means that, in general, there is to be no discrimination between national and other suppliers in purchases made by government or their agencies. Many developed countries were signatories to this. However the scope of the agreement covers only the agencies specified by the government on signature, and thus several

---

1/ Feketekuty, G. and Aronson, J., "Meeting the Challenges of the World Information Economy", The World Economy, Vol.7, No.1, March 1984, pp. 63-86.

2/ OECD "Annual Reports on Competition Policy" 1982/No.2 - 1983/No.1 Paris 1983.

exclusions were made. PTTs in Western Europe are still free to discriminate in their non-postal purchases, i.e. those for telecommunications purposes. On the other hand, Japan's PTT, known as NTT, is under the code and thus may not discriminate in its purchases.

As for Japan, a specific bilateral agreement exists with the United States, but opinions on its effects are mixed. A United States Senate report says it has so far produced little in the way of NTT orders from the United States, and quotes an Electronics Industry Association estimate of United States telecommunications exports in 1982 to Japan of $40 million, with United States imports from Japan being $1,000 million.[1/] But the United States Government regards the agreement as valuable.[2/]

The denationalization of Japan's NTT is under discussion with half of its equity expected to be offered for sale in April 1985. The questions of whether foreigners will be allowed to invest and what effect the denationalization will have on purchasing policy are as yet unclear.

The GATT code on public procurement has a further possible limitation in that contracts of value less than SDR 150,000 (about $196,000) are not covered by it,[3/] with a provision that contracts greater than this in value should not be split up to avoid the operation of the code. This is significant because the steadily falling prices of informatics equipment means that many items (including computers) would thus be outside the scope of the code.

1/United States Senate Committee on Commerce, Science and Transportation, "Long Range Goals in International Telecommunications and Information", Washington, 1983.

2/See speech of L.N. Olmer, United States Under-Secretary for International Trade, Honolulu, 1984, to the Sixth Annual Pacific Telecommunications Conference.

3/Huerni, B.S. "Restrictions on International Competition through Government Measures" Intereconomics, March/April 1983.

Table 15: Tokyo Round agreements: status of acceptance by developing countries[a/] (as of 2 December 1983)

	Technical barriers	Government procurement	Subsidies count. duties	Customs valuation	Import licensing	Civil aircraft	Anti dumping
Argentina	S	O	O	S[b/]	S	O	O
Brazil	A	O	A	A[b/]	O	O	A
Chile	A	O	A	O	A	-	O
Egypt	A	O	A	O	A	S	A
India	A	O	A	A[b/]	A	O	A
Republic of Korea	A	O	A	A[b/]	-	-	-
Malawi	-	-	-	A[b/]	-	-	-
Pakistan	A	-	A	O	A	-	A
Philippines	A	O	O	O	A[b/]	-	O
Rwanda	S	-	-	-	-	-	-
Singapore	A	A	O	O	O	O	O
Uruguay	-	-	A	-	-	-	O

Source: Lütkenhorst, W. "GATT - Caught between self-destruction and reform", Intereconomics, July/August 1984.

Notes: A = Accepted S = Signed (acceptance pending); O = Observer

a/ Includes only those developing countries which accepted or signed at least one of the Agreements.

b/ Reservation, condition and/or declaration.

The EEC Commission has recently put forward comprehensive proposals to standardize and harmonize telecommunications within the community. This will involve agreements between all member governments and PTTs on common strategies, joint research, and mobilization of financial resources for this purpose. The purpose of the EEC plan is three fold: to provide a service to users to maintain and improve their competitiveness, to stimulate EEC production so that the EEC will "... continue to be the world's leading exporter" and to enable the operating bodies to "... face up to the technological and industrial challenges ...".1/

The measures of the plan are of four kinds, in line with the above purposes. The first is the creation and stimulation of a community telecommunications market, with common standards and also with the full opening of bids for terminal equipment to an EEC-wide market and a partial opening for other equipment. It may be noted that these measures do not cover potential suppliers outside the EEC. The other measures are the development of common strategies to reduce uncertainties, the initiation of EEC research and development programmes, and aid for the improvement of telecommunications networks in the least-favoured regions of the EEC.

5.5 Technical standards

Technical standards for telecommunications equipment are regulations which can constitute non-tariff barriers to trade. As noted above, telecommunications are a state monopoly in many developed countries. These monopolies are often in a position to set and enforce standards for connection of any equipment to their systems and in some cases to forbid by law any connection until the equipment has been tested and approved by them. An external supplier may thus be faced with a set of standards which have been set without reference to him and, conceivably, determined in the light of domestic suppliers' concerns. In any case the mere fact

1/Bulletin of the European Communities, No.5, 1984.

of different standards means, for the exporter, market fragmentation and a diversity of requirements which can be met only by a large and flexible operation. The United States Senate report already cited identifies these standards as an obstacle to United States exports, going so far as to say that "standards of other countries are often different from those in the United States and have arguably been applied to discriminate against U.S. firms."[1/] The report notes the delays often inherent in the approval process but says technical barriers are more of an obstacle to telecommunications than to information equipment. Technical standards as a specific obstacle to imports (rather than to connexion) are noted for Algeria, where an authorization dependent on certification as to technical standards is required for various electrical measuring instruments, and for Chile where some items under the broad groups of calculating machines, computers, telegraph and telephone equipment, and measuring instruments, also require an authorization dependent on certification with respect to health and safety.[2/]

On the other hand, the steps towards deregulation noted above do seem to be associated in some cases (e.g. Canada and the United Kingdom) with a tendency towards liberalization in technical standards, especially in the approval of equipment connection.

5.6 Sectoral Policies

As described in earlier chapters, informatics and its equipment has been "targeted" as a key sector by many countries, both developed and developing. In general, targeting policies can have the following

---

[1/] United States Senate Committee on Commerce, Science and Transportation, "Long Range Goals in International Telecommunications and Information", Washington, 1983.

[2/] UNCTAD Data Base on Government Trade Measures of a Product-Specific Nature.

components as noted by the IMF, and all these have their effects on trade, since they amount to direct or indirect support for domestic industries:

> "Targeting" policies may include subsidies, pro-merger policies, protection of the favoured sector from imports, buy-national procurement policies, discriminatory technical standards, and eventual export expansion from the secure home base."1/

Targeting can have overt effects, such as in Brazil, where specific performance requirements already enforce local content in much of informatics trade. Further protection of the domestic informatics industry in Brazil is embodied in new legislation now adopted. It gives the Government wide powers to restrict the production or trade in goods and services related to the computer and data processing industry. A range of incentives from tax exemption to priority in obtaining official credit will also be provided.2/ Mexico, the second largest Latin American user after Brazil is now introducing import restrictions in order to further the development of its own industry.3/ Argentina's ban on imports of computers with memory up to 256K appears to have arisen from general foreign exchange considerations rather than sectoral targeting.4/

However, targeting of the informatics sector inevitably affects trade in informatics equipment. Even if the targeting policies do not explicitly include protectionist measures, the mere fact that the sectoral policy exists and involves a commitment of national resources to the development of the informatics sector will be enough to induce protectionist pressures to safeguard the investment made.

1/IMF "World Economic Outlook 1984" Occasional Paper No. 27, Washington 1984.

2/Financial Times, August 1984.

3/Tigre, P. "Technology and competition in the Brazilian Computer Industry", London, Francis Pinter, 1983.

4/Cohen, E., Dmitruk, A., Godel, A. "Information Technology in Argentina", UNIDO ID/WG.419/9, 15 June 1984.

5.7 Valuation principles

Import duties are applied to the value of the import concerned. But just what this value is can sometimes be disputed, since the real value of goods may not, for various reasons, always be reflected in the invoice or declared price.[1/] The subject was extensively discussed during the Tokyo Round and uniformity of approach to what is called the valuation question is still lacking.

This has obvious relevance to informatics equipment, since "bundled" software and "firmware" are increasingly important. "Bundled" software is sold with a computer as a package deal. "Firmware" is the software that is more or less permanently in the computer or other equipment in ROM (Read Only Memory). Valuation of the different components of an informatics package thus becomes an interesting question, already under discussion in GATT's Committee on Valuation, where differences of approach are evident. Some countries apply to a computer tape only the relevant tariff for the physical tape itself, ignoring what may be on it, others including France, propose applying duty to the whole value which for some pieces of software may be considerable.[2/] The latter approach is gaining ground. This question seems to have arisen as yet only in the area of magnetic media: in view, however, of many legal battles on the copyright of ROM-based software, it may be only a matter of time before valuation difficulties emerge in this area also.

1/ GATT "The Tokyo Round of Multilateral Trade Negotiations". Report by the Director-General, April 1979.

2/ Feketekuty, G. and Aronson, J., "Meeting the Challenges of the World Information Economy", The World Economy, Vol.7, No.1, March 1984, pp. 63-86.

Chapter 6
CONCLUSIONS

Two major themes underlie the above survey. The first is the growing interdependence of the fields of computing and telecommunications. The processing of information and the collection and distribution of it are continuing to merge in technology, in organization, and in economic terms. The strategic implications of this include a recognition that the development of these technologies is not just to maintain or increase a competitive edge but to serve the development of the economy as a whole. For the manufacturing sector this can mean not only process control, automation, robotics and CAD (Computer Aided Design) it can mean also improved planning, decision making, and marketing. Informatics therefore not only transforms the manufacturing process but the environment in which it operates.

The second theme is the increasing role of government policies. These policies, now adopted and being implemented by many developed countries, although with different resources and time-horizons, have obvious implications for the developing countries. For they imply a need to devise strategies that take these policies, just as much as the technologies, into account. A further implication is that government policies in informatics will inevitably produce pressures towards increasing protectionism of the types discussed above. The commitment of resources made will mean that policies, explicit or implicit, for the safeguarding of these investments are likely to emerge as a consequence. Thus the restrictions on trade in informatics equipment described in this note may well be added to in the future.

In the light of this survey, as well as of the special characteristic of advanced technologies such as those in the informatics field, a number of elements must be considered in the formulation of strategies for informatics development. The following paragraphs attempt to summarize these.

The information concepts that underlie present and future development in informatics need to be explicitly recognized and incorporated in the national strategy. The goal of the strategy cannot only be to become a producer of informatics equipment whether for export or for import-substitution. It must also be to provide the kind of "information infrastructure" that can enable the rest of the economy to function efficiently and competitively. As a complement to this, the informatics industry will require inputs from many sectors and disciplines, and must thus occupy a central place in the industrial complex.

A second is that of medium and long-term technological assessment as part of the process of policy design. Despite the fact that this assessment is vital to the rational allocation of resources, manpower training and the design of R&D programmes, more often than not it is not included. In all fields, technology moves within an approximate range of certainty. Although it is not possible to forecast accurately technological change, it is possible to assess the basic range within which technology will move in the medium and long term. Given the accelerating change under way in the informatics field, such assessment is essential. Both Japan and France have shown that it is possible and desirable to make this assessment before implementing detailed national policies. An exercise of this nature serves to focus the concerns of different groups and helps to judge the possibilities of developing long-term comparative advantages.

A third element is concerned with institutional intricacies and the social consensus that is needed in order to develop a national policy in high technology. By definition, high technology has cycles of development and maturation which are often longer, and certainly very different, to those of politico-social or business processes. This means that a broad socio-political consensus is necessary to maintain the policy over time in order to achieve consistency and to justify the long-term investment. It is important to remember that, in the late 1950s, the first measure implemented in Japan to design a policy in electronics was the creation of conditions for the development of academic, professional and business associations through which the different groups concerned with the electronic sector could discuss their views, make propositions and produce the relevant studies. This institutional system and the interaction between different groups has been critical to subsequent developments in policy and is one of the factors which explains the Japanese success in electronics. The lesson to be learned is that those who are going to be affected by policy must participate in its design. This may make the design process more cumbersome and time consuming but the actual implementation will be faster. As a bonus, there will be the creation of informal contacts between industry, government and academia.

A further element is the development of technological capacity. Technological capacity refers to the existence of human and other resources necessary to acquire and develop technology. This is the R&D capacity in the universities, state or industry laboratories, university training courses, and technology intelligence. This latter covers knowledge of trends and of actors active in the field, centres of excellence and the current state of the art. Many countries, including developing ones, have important technological capacity and are capable of producing highly sophisticated techonological products (e.g., India for telecommunications satellites or Argentina in nuclear energy). The critical problem for developing public industrial policy in high technology is the need to build a "conveyor belt" between centres of technology and industry, or from R&D to production and marketing in industry.

Another element is innovative capacity, which is here intended to mean a full process of development, production and marketing of new products, processes or services. Innovation does not necessarily mean invention or advances in the state of knowledge but rather new production systems that create new markets or replace old products with new ones. Products need not necessarily be the most advanced technologically if the company has the capacity to produce, market and service them effectively.

Trade policy should be supportive of the strategy, but there is more to this than might first appear. The "infant industry" argument that is sometimes applied would suggest that domestic producers should be safeguarded against competition (e.g. Brazil). But consideration needs also to be given to the longer-term and to the above recommendation on information infrastructures. National development of informatics equipment will need also national application of the results. To do this a new climate of familiarity with the application of these technologies needs also to be created. There may thus be a good case for a very liberal import policy in selected fields (e.g. in cheap microcomputers and components) in order to spread the new technologies as widely as possible among schools, universities, consumers and small enterprises. A relatively small foreign exchange loss, perhaps no more than the cost of one super-computer, might bring significant benefits in the fields of skill development, innovation and sensitization.

Finally, it must be stressed again that the policies of other countries must be fully taken into account in the formulation of a national strategy. It is not enough to recognize the spread and speed of change, such as in a medium and long-term technological assessment as described above, and to try to follow it. The policies already being followed, especially in the developed countries, are now determining the technology and the markets for years to come. These changes will come in spite of any policies adopted by developing countries, some of whose best hopes therefore are to be found in a reasoned assessment of prospects for the future, a detailed identification of special niches and opportunities in world markets, and, most importantly, comprehensive plans to apply these technologies in their own industrial development.

It has not been the purpose of this paper to forecast the dimensions of change in this field in the future, nor to give predictions of how the development of informatics technology will alter the economic structure of production and society, nationally or internationally. But it is clear even from the expressed perceptions of governments that the changes will be very great.

A further indication of the magnitude of change to be expected is found in the fact that these policies are in some cases implemented in economies where the role of the private sector is the leading one and where competition between private companies, rather than government-sponsored co-operation between them, remains a preferred course. The move towards government intervention therefore shows how seriously the position is viewed.

Indeed, some of the policies pursued can be characterized as reactions rather than initiatives, essentially defensive responses to accelerating technological change and the international strategies being adopted by other countries and private companies who are mastering and determining that change. Whether the response is adequate remains a most important question for both developing and developed countries.

Selected Sources

Brazil

- Secretaria Special de Informatica (SEI), Brasilia, several reports and documents.

- Brizida, J., "Brazil and Transborder Data Flows" in Rada, J.F. (ed.), Communications Regulations and International Business, North Holland, 1984 (forthcoming).

- UNCTC, Transborder Data Flows and Brazil, New York, 1983.

- Rada, J.F., The Impact of Microelectronics: Some Latin American Cases, Paris, UNESCO, 1982.

Far East

- UNCTAD, Electronics in Developing Countries: Issues in Transfer and Development of Technology, Geneva, 1978.

- Cable, V. and Clarke, J., British Electronics and Competition from Newly Industrializing Countries, Overseas Development Institute, London, 1981.

- Hong Kong Government, Report of the Advisory Committee on Diversification, Hong Kong, 1979.

- Journal of the Asian Electronic Union, "Survey of Korean Electronics", March, 1980.

- Kim, W.H., "Challenge to US Domination: The Promises of Technology for Newly Industrialized Countries" in Financial Times Conference: World Electronics, Strategies for Success (Monte Carlo), London, 1980.

France

- Fabre, J.J. and Moulonquet, T., "L'Industrie informatique" in Nora S. and Minc, A. (eds.), L'informatisation de la société, Paris, 1978, Vol. II, Annexe 7.

- Lorell, M., International Development of Large Aircraft - The European Experience, Rand Corporation, 1980.

- Report by Francois Mitterand, President of France, to the Summit of Industrialized Countries, June 1982, "Technology, Employment and Growth", Paris 1982.

- Madec, A.J., "Les flux transfrontiers des données", La documentation francaise, 1983.

Germany, Federal Republic of

- De Vos, D., Governments and Microelectronics: The European Experience, Science Council of Canada, 1983.
- OECD, DSTI/ICCP/83.2, February 1983.
- Mackintosh Consultants, Microelectronics Into the '80s, Luton, 1979.

India

- Government of India, Annual Report of the Department of Electronics, 1982-1983, New Delhi, 1983.
- "The Electronics Plan, 1978-1983" in Electronics, Information and Planning, New Delhi, October 1978, Vol. 6, No.1.
- Kashyap, A., "The EEC Computer Software Market and the Possibility of Import from India", International Management Institute - IMI, MBA thesis, (mimeo), 1983.

Japan

- Moritani, M., Japanese Technology, Simul, Tokyo, 1982.
- Gregory, G., The Japanese Propensity for Innovation: Electronics, Sophia University Business Series, No.86, Tokyo, 1982.
- "Miti's Vision of the '80s" is recorded in full in Welke, H.J., Data Processing in Japan, North-Holland, 1982, Annexe 1 (a).
- Feigenbaum, E. and McCorduck, P., The Fifth Generation, Addison Wesley, 1983.

Spain

- Ministerio de Industria, Secretaria General Tecnica, Directrices para la elaboracion de un plan nacional de la industria electronica, Madrid, 1983.
- Ministerio de Industria y Energia, Plan electronico e informatico nacional: Programa econ.mico a medio plazo 1983-1987, Madrid, 1984.

United Kingdom

- Advisory Council for Applied Research and Development (ACARD), The Application of Semiconductor Technology, London, 1978.

- Braun, E., Hoffman, K. and Miles, I., "Microelectronics and Government Policies - The Case of One Developed Country", UNIDO-ECLA Expert Meeting, Vienna, 1982 (mimeo).

- There are numerous publications in the form of brochures from the Department of Industry, the Technology Group and the Ministry of Information Technology. This is promotional material that contains the specific details of the many public programmes in the United Kingdom.

United States

- For a detailed assessment of the historical role of the United States Government support for innovation, see Nelson, R. (ed.), Government and Technical Progress, Pergamon Press, 1982. It includes analyses on semiconductors, computers, commercial aircrafts, agriculture, pharmaceuticals, construction and commercial vehicles.

- Congress of the United States, Joint Economic Committee, International Competition in Advanced Industrial Sectors: Trade and Development in the Semiconductor Industry", Washington, 1982.

- Congress of the United States, Subcommittee on Trade, High Technology and Japanese Industrial Policy: A Strategy for United States Policy Makers, Washington, 1980.

- United States International Trade Commission, Competition Factors Influencing World Trade in Integrated Circuits, USITC Publications, Washington, 1979.

- Hertzfeld, H.R., The Impact of NASA Research and Development Expenditures on Technological Innovation and the Economy, in European Space Agency, Economic Effects of Space and Other Advanced Technologies, Paris, 1980.

- Semiconductor Industry Association (SIA), The Effects of Government Targeting on World Semiconductor Competition, Cuptertino, California, 1983.

- Semiconductor Industry Association (SIA), An American Response to the Foreign Industrial Challenge, Cuptertino, California, 1980.

R & D

- OECD, Trends in Industrial R&D 1967-1975, Paris 1979.

- Mouy, P., "Le rôle des marchés militaires dans le développement des industries electroniques", in Analyse Financiere, Paris, 1980.

Other Documents on Public Policy on Electronics

Algeria: - Commissariat National à l'informatique, L'informatique en Algérie, la stratégie de son développement, Alger, 1979.

Canada: - Science Council of Canada, Planning Now for the Information Society, Ottawa, 1982.

- "Telecommunications and Canada" in Consultative Committee on the Implications of Telecommunications for Canadian Sovereignty, (Clyne Report), Ottawa, 1979.

.09.23