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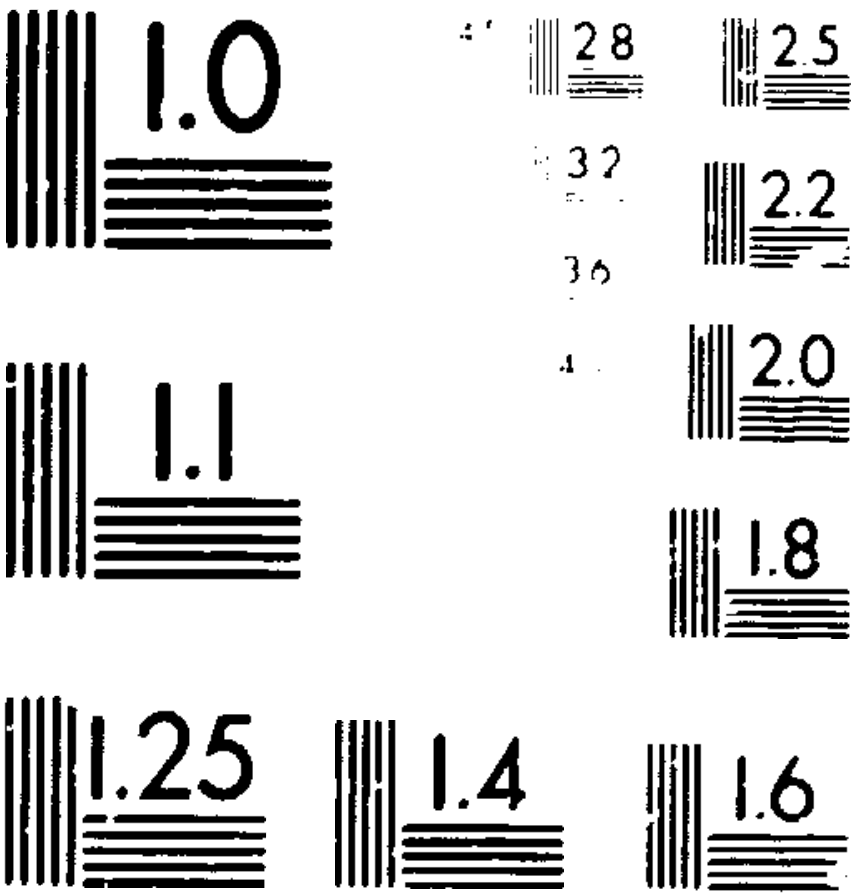

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INFORMATION TECHNOLOGY IN ARGENTINA

National Policies and Needs*

by

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UNIDO Consultants

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INTRODUCTION

This paper aims at giving a brief description of the national policies applied to information techology and at offering a view of the country's prior needs in this respect.

In the first place, it is to be pointed out that, for the most part, neither the policies nor the needs arise from explicit official pronouncements; they derive from the personal view held by the authors on this matter. The reason for this is that, the country having so far lacked an explicity manifest policy on the subject of informatics*, the policy implicit in the various measures adopted by the authorities must be subjectively inferred by those who analyze these facts.

A first reading of the facts in question shows that, for the greater part, these measures have been adopted as the result of macro economics consideration which: a) overlooked the sector's particular needs and b) did not aim at specific targets in the sector.

However, it should not be concluded from the above that the country is not interested in informatics, or that there is a lack of awareness as to the increasing importance this technology is gathering all over the world. On the contrary, many sectors are deeply concerned with the subject which has also been studied by various official committees and discussed at conferences and seminars.

Consequently, the lack of an explicit government policy reflects, on the one hand, that the sector was being subjected to a more general political philosophy based on "letting the market decide" which has prevailed in official spheres for the last few years. On the other hand, it shows that the consensus necessary to define a clear-cut policy has not yet come to a stage of maturity.

In other words, while in the last few years a "laissez faire" policy has prevailed in official spheres, this has not altogether hampered the implementation of specific policies in those sectors where consensus had been reached and vested interests -both burocratic and industrial- have grown as was the case with the petrochemical industry and with the field of nuclear energy. Therefore, the lack of an informatic policy shows that we are a long way away from having reached a final conclusion in the discussion of the ways such policy will follow.

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* Some documents about national policy on informatics have been issued in the last few years by the Undersecretary of Informatics. They dealt with the use of computers in education and administration, the incumbencies of university degrees and so on. Because no resolution or executive measure derived from those guidelines we do not consider them to be an explicit government policy.

Since both the policies and the needs arise from the global context of the country, we should first outline the national present situation of information technology as a framework where we can insert the particular subject on which we are focusing.

Finally, on reading whet follows, it should be borne in mind that Argentina is at present emerging from a very difficult time during which a regressive economic policy attempted to alter the national trend of evolution. The social, cultural and economic aftermaths brought about by the attempt will, in future, condition the desirable to the possible, as the government will have to give absolute priority to healing the wounds of the social body, even when this may mean postponing the implementation of programs of great impact in the medium and long term but with a high present cost.

In this paper, most of the time we use the concept of information technology in its more narrow an usual meaning in our country-that is mainly refered to computer products both software and hardware- even if we agree with the meaning UNIDO is giving to the term wich"refers to the rapid and convergent developments which have taken place in the fields of computing, systems analysis, telecommunications as well as microelectronics and is concerned with the production,storage,processing and transmission of information".
That is so because national policies up to now only have taken care of the most visible and big portion of the information technology market, that is office machines and computers products, and because it was difficult to cover a broader field in a brief paper like this. Nevertheless,the presente situation described here for the most significant portion of the information technology market can give an idea of the whole.

In writing this paper we have drawn heavily from the papers and studies listed in the bibliography though no specific mention of sources are made throughout the text for reasons of brevity.

1.- PRESENT SITUATIONS OF INFORMATICS IN ARGENTINA

1.1 - Computers installed

Tables 1.1 to 1.4 show both the situation and the historical evolution of the Argentine total computer installation based on data compiled by the Undersecretariat of Informatics.

These machines serve predominantly traditional applications i.e. administrative and accounting systems. There are, of course, non-traditional applications such as process control systems, graphic CAD/CAM systems, systems for scientific uses, etc but on the whole these are in their preliminary stages and they do not amount to a significant figure within the total number.

From the data mentioned, it is remarkable that teleprocessing development should not have evolved together with the computer installation. This is explained by the characteristics of the national telephone service. Although the number of telephones every 100 inhabitants (10 in 1980) is larger than usual values in other developing countries, telephone communications are defective, and the availability of dedicated lines, either local or long-distance, is quite scarce.

As from this year a packet switching data-transmission network will gradually come into service. This is expected to solve the problem in part, particularly for the largest systems. However, there will still be trouble with teleprocessing, which is made up of small systems using switched lines.

CLASS 1: IBM 5010

CLASS 2: IBM 8130, S/1, S/34

CLASS 3: IBM 4331, S/38, 370/115

CLASS 4: IBM 4341

CLASS 5: IBM 3031, 3032, 370/158

Table 1.1: Class division of computers installed on comparisson with IBM models.

Source: Undersecretariat of Informatics

	Public Sector units	Private Sector units	Total units
Microcomputers	332	2685	3017
Word processing	49	244	293
Class 1	443	3913	4356
Class 2-5	547	3362	3909

Class 2-5	76,9%	Class 2
	15,9%	Class 3
	5,5%	Class 4
	1,7%	Class 5

Table 1.2: Class divisions of the total Argentine computer installation up to December 31st, 1982

Source: Undersecretariat of Informatics

	Number of CPUs units	Terminals units	Average terminals per computer
Microcomputer	3017	26	--
Word processing	293	125	--
Class 1	4356	1079	0.2
Class 2	3006	10915	3.6
Class 3	621	4280	6.9
Class 4	215	5872	27.3
Class 5	67	6149	91.8

Terminals	Local	83%
	Remote	17%

Table 1.3: Installed computers and terminals classified according to class up to Dec. 31st, 1982

Source; Undersecretariat of Informatics

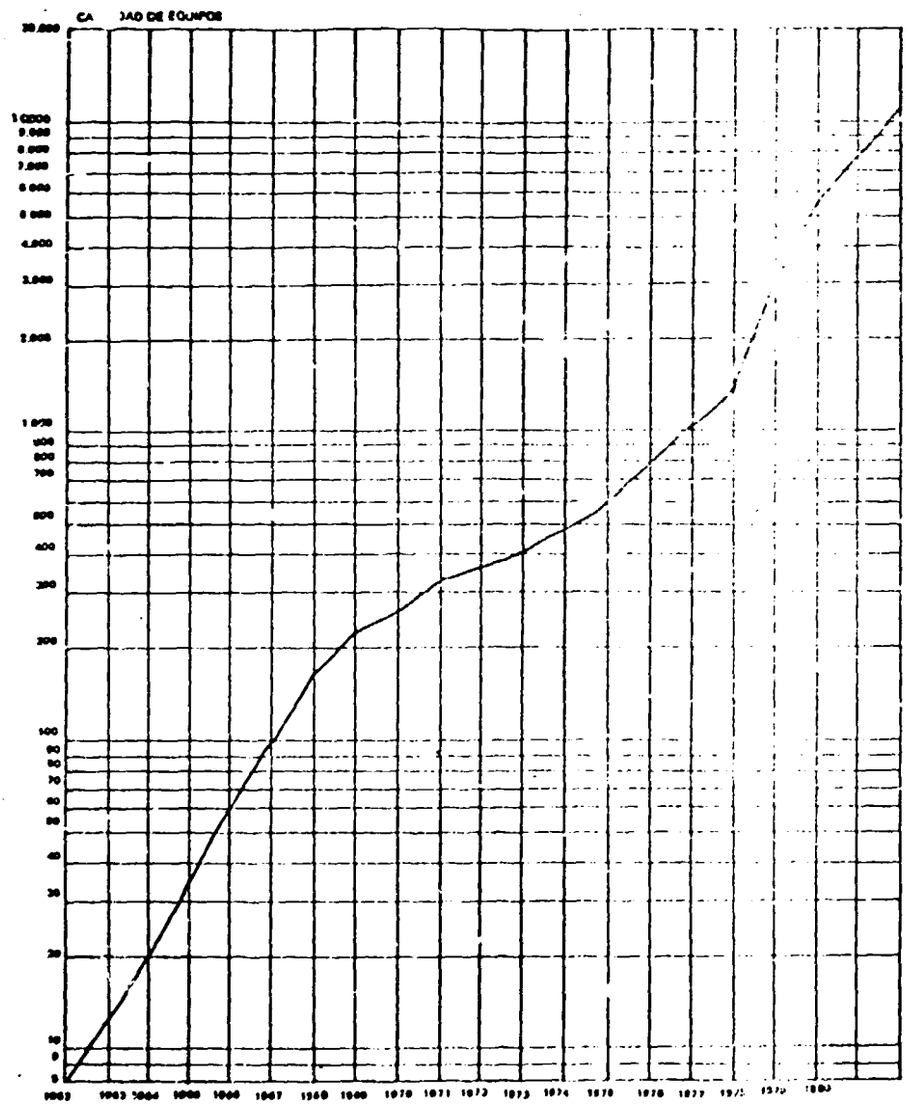

Table 1.4: Historical evolution of the Argentine computer installations

Source: Undersecretariat of Informatics

1.2 - Market

Information on annual sales of computer products can be built on Customs statistics or on estimates supplied by commercial sources.

The first item -annual imports of computers and their peripherals in current dollars at FOB prices- appears in Table 1.5.

Estimates from commercial sources value annual sales in current dollars at final user prices. The market estimate for 1979 was of 127 million dollars, bordering on 400 million for 1980, 224 million for 1981 and 142 million for 1983.

These data show the impact of the recession that began in 1981, as well as the booming increase in sales as from 1979.

Table 1.6 compares this market with that of other countries for 1980 and 1981.

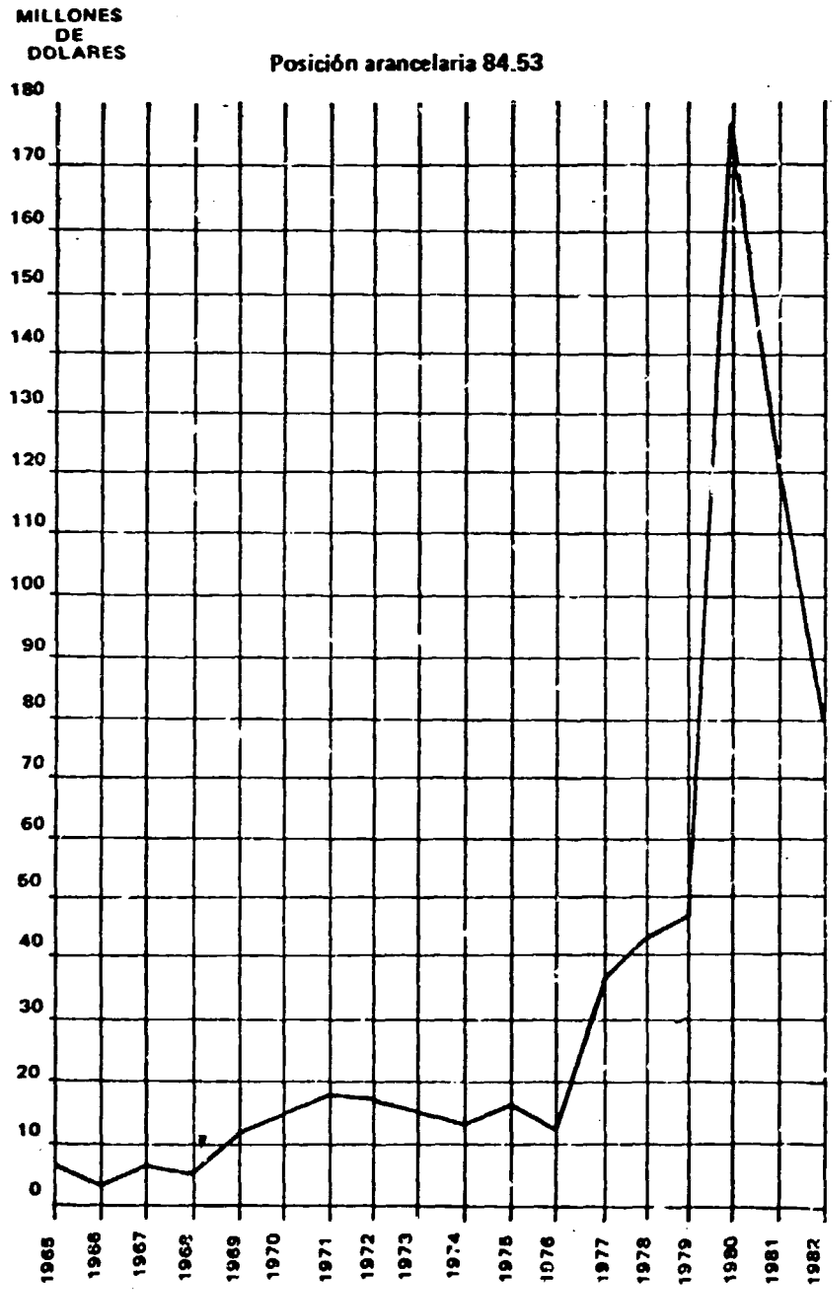

Table 1.5: Annual imports of computers and their peripherals in current dollars at FOB prices

Source: Undersecretariat of Informatics

	MARKET VALUE - US $ million		
Country	1980	1981	% growth
USA	30733.8	35951.6	16.9
Japan	8355.9	9408.9	12.6
Western Europe (total)	17090.9	19212.4	12.4
West Germany	4607.3	5064.2	9,9
France	3523.7	4033.9	14.5
United Kingdom	3524.0	4025.8	14.2
Italy	1673.6	1924.0	15.0
Benelux	1308.9	1428.8	9.2
Scandinavia	958.7	1080.0	12.7
Spain	824.4	916.6	11.2
Switzerland	406.8	449.1	10.4
Brazil	755.6	1008.0	33.4
Argentina *	400.0	224.0	-44.0

Table 1.6: Estimate of the computer and related equipment market in various countries (1980 - 1981)

Source: Tigre, P. Technology and Competition in the Brazilian Computer Industry (Frances Pinter, London, 1983)

* Data for Argentina: own sources

1.3 - Industry

In 1983 Argentine informatic industry produced 90 million dollars worth of goods. Of the total amount, 80 million belonged to IBM's local plant. This is an export factory employing 540 people and manufacturing serial high-speed printers whose local added value is about 65%. It is to be pointed out that this company is not a typical instance of Argentine industry, particularly as regards the field of electronics.

The local branch of Texas Instruments assembles microcomputers with a very low added value, its production value in 1983 being about 5 million dollars at consumer prices.

Finally, Microsistemas, a local capital enterprise, manufactures various models of microcomputers and data-entry equipment under their own trademark and without any formal licensing, employing about 100 people, with a high percentage of qualified professionals devoted to R & D. The value of their production, at consumer prices, was about 5 million dollars in 1983.

In addition, there exist several small scale enterprises with a good technological capacity, engaged in the production of dedicated systems or of small series of special systems based on the use of microprocessors; such enterprises work under their own trademarks and without any formal licensing.

Whereas, for the time being, their production lacks significance from an industrial and/or economic point of view, their presence in the market shows that a significant standard of technological maturity has been achieved in the field of microcomputers.

As will be seen in section 2.1, this outlook means a relative setback from both the quantitative and the qualitative points of view, if compared to the situation in 1976, since local production satisfies a much lower percentage of the demand, and national technological contributions are poorer now than they were at that time.

1.4 - Human Resources

It is estimated that up to 1983 the total number of university graduates in electronic engineering after a six-year course of studies was about 7800 engineers, coming down from 14 different university schools, both private and state-run.

The number of graduates anticipated for 1984 is 650, the annual graduation growth rate being 4% in the last few years. Half the graduates finished their course of studies after 1978.

No estimates exist for professional demand after 1980. At that time it was estimated that while 4300 electronic engineers were working in the country, only 1400 of them were employed in the electronic industry.

Professional exodus, for which no figures exist, has been quite significant, as are unemployment and underemployment. Argentina does not offer post-graduate university courses leading to the Ph.D. level of American universities. Furthermore, the curricular training of university graduates is of a traditional sort, with very slow absorption of the latest technological innovations. In this respect it might be said that training is still poor in the fields of microelectronics and informatics.

The last decade has seen the advent of a good educational structure in electronics at secondary school level. There are 24 schools, both state-run and private, which have trained about 15.000 technicians with an average annual graduation rate of about 1200 technicians.

University development in areas connected with software has been slow and chaotic. While the first university course was created in the sixties, quantitative development appeared only in the last few years. At present there exist 32 different university courses related to the area, such as systems analysis, systems engineering, scientific programming, scientific computer applications, operation research, etc, with a marked concentration in private universities. There are also a dozen institutes most of them private, which hold post-secondary, non-university courses in systems analysis, and two educational institutes at secondary level directed to the training of programming technicians.

It can be estimated that about 500 professionals graduate from universities each year, all of them specialists in fields related to informatics, and as many others graduate from post-secondary institutes. In all cases, the curricula involved are strongly oriented towards business-administrative uses.

In 1979 a deficit of 3000 specialists was estimated over a total employment figure of 15.000 people. There are no later estimates, although it is felt that this has not resulted in a shortage of staff, probably because recession has hindered the sector's dynamics.

It should be underscored that most of the staff employed by data-processing centers either lacks systematic training or has acquired it in related careers such as economics, engineering, mathematics, etc.

1.5 - Research and Development

R & D activities on information technology -both hardware and software- have a long tradition in Argentina, for they began in the late 1950's, although their practical results have not come up to the expectations aroused by their early start.

This may be due to the lack of a parallel industrial development that might claim both highly qualified human resources and concrete results transferable to production.

The first activities were staged at Buenos Aires National University -development of a transistorized Computer (1958 - 1962), and development of software parallel to the exploitation of a Mercury-Ferranti tube computer (1960-1966)- and the Southern University -computer architecture- as from 1958. In the 1970's the State Secretariat of Science and Technology organized the National Electronics Programme, which coordinates and to a certain extent finances the activities of the many groups -most of them small- working on this field in various official academic institutions and laboratories. It is estimated that about 1000 people work on electronic R & D activities at different laboratories, most of them belonging to universities, 500 of them being university graduates. Of these about 300 are engaged in tasks related to information technology, mainly in microprocessor applications, digital techniques and software -including basic software- for microprocessors. Most of the work being done has to do with the development of prototypes for microprocessor applications to industrial control, process control, electronics in medicine, instrumentation, telemetry and communications and, to a lesser degree, with the development of computer products.

From the R & D groups mentioned -more than 40- half a dozen arrived at a significative dimention. Among the most important there can be pointed out CETAD (industrial analog and digital applications) at La Plata University; National Atomic Energy Commission (control and instrumentation), INTI (instrumentation, control, industrial applications and communications) , Numeric Control at National Technological University - Cordoba (numeric control, robotics and industrial applications),LANTEL (National Telecommunications Laboratory), Bioelectronic Engineering Institute at Buenos Aires University and CENICE (Electronic Component Research Center).

The Program coordinates all these activities putting together an increasing number of working groups.

As no such entity as the Electronic National Program coordinates R & D activities in the field of software, mainly that for minicomputers and vast systems, it is not possible to offer a comprehensive view of this field. The prevailing feeling is that in this issue, development is still at the preliminary stages.

In the private sphere, R & D concentrates in industrial companies that deal in microcomputers. It is estimated that at least 200 people are engaged in this activity, generally in very small groups. This implies a setback if compared to the situation in the seventies, when FATE gathered some 80 university graduates who devoted their effort to the development of desk calculators and acccunting machines, including basic software for the latter.

Some development of software for larger systems is also being undertaken in the private sphere, although there are very few instances of achievement beyond the traditional applications to business administration and accountancy. Among the few there are, one might mention, the development of a basic graphic CAD/CAM packet, and an application of teleprocessing to the handling and automatic allocation of ambulances and hospital room in case of medical emergency.

One of the main objectives of the PNE (Electronic National Program) has been the promotion of microelectronic components development. Most of this work is done at CENICE (Electronic Component Research Center), a R & D institution supported by the National Scientific Research Council (CONICET), Communications Secretariat and Armed Forces Research Commission (CITEFA) and sponsored by the PNE.

CENICE employs at present 55 people, most of them university graduates in physics and engineering.

Current activities at CENICE are:

- Monolitic IC design (C.A.D.) and process development.
- Hybrid circuits manufacturing at pilot plant level.
- Bipolar technology component manufacturing at pilot plant level.
- CMOS devices pilot plant project.
- Quality control on microelectronic devices manufacturing processes.

Among the most important R & D institutions of the country is the National Institute of Industrial Technology (INTI), whom the authors of this paper belong.
INTI is a governmental institution whose aim is to privide technological support to industry and services, mainly those of medium and small size. It employs around 1500 peaple,40% of them holding university degrees on physics, chemistry,mathematics, engineering, computer sciences and so on.Its facilities are diseminated throughout the whole country, though 70 % of its personnel works in a technological and industrial park situated at Migueletes in the neighborhood of the city of Buenos Aires.
As a consequence of several actions that the national authorities are presently carrying out and which will be described later on, the authors believe that INTI will play an increasingly important role on activities in the information technology field.
Two of INTI's branches are the Electric and Electronic Measurements group and Microprocessor Division, located together in a new building of about 1000 square meters, and employing nearly 50 peaple.Current activities are:

1) Electric and Electronic Metrology, which includes the operation and maintenance of the national measurement standards,the development of measuring instruments and methods , and testing and evaluation of components and equipments.
2) Measurement and control of EMI generated by electric and electronic equipment,with particular emphasis in those of industrial type.
3) Development and design of microprocessors applications, in

particular in the field of instrumentation and control.

4) A group which is working in a project whose aim is to develop a CAD/CAM capability for applications on the electronic and electric field expandable to mechanics.
5) Observation and analysis of tendencies, both internal and international on electronic technology, production and trade, and the elaboration of strategies and long term plans for the development of the argentine electronic industry.

Other INTI's groups are already working in fields related with the information technology field:

1) Machine Tools Center, which includes a group working in CNC and robotics.
2) Data Processing Center, which operates the computer for the technological park users, provided with an internal network of 40 terminals and a connection to the public data transmission network, and gives software support for both internal and external users.
3) A group working on transducers and sensors and their corresponding interfaces.

1.6 - Conclusions

Table 1.7 briefly illustrates the steps or stages developing countries must go through in order to achieve the mastery of a new technology.

If we divide the level spectrum of information technology into three wide sectors, mainframes, minicomputers and microcomputers, it is clearly seen from the above that Argentina stands on the first step as regards mainframes is concerned, and on the third step as regards microcomputers, and is in a position to reach the third step for minicomputers with some effort.

	Stage	Incorporated activity	Acquired capacity
Pre-industrial stage	1st.	Utilization	Operation and maintenance
Industrial stages	2nd.	Mounting, assembly & quality control	Industrial production
	3rd.	Local integration of parts & components	Product engineering Adaptation development
	4th.	Independant research and development	Generation of technology

Table 2.7: Technological and industrial stages in developing countries

Source: Estudio sobre el Desarrollo de la Industria Electrónica en la Argentina. Conceptos Fundamentales, INTI - 1981

2.- NATIONAL POLICIES RELATED TO INFORMATION TECHNOLOGY

2.1 - Up to 1976

The import substitution policy was applied to business and statistics machines -most of them electromechanic at the time- by means of multinational investments, IBM and Olivetti being the most significant ones.

The creation of the Latin American Association for Free Trade (ALALC) and the negociation of business machines within this framework conditioned the industry's evolution. It specialized in desk calculators and accounting machines, in a pattern of regional complementation that was influenced by whatever suited multinationals best.

For their part, IBM quickly developed into a pattern of product complementation within their own worldwide organization.

In the case of desk calculators and accounting machines, a local capital enterprise (FATE SA) took the lead in replacing electromechanic technology for electronic technology. With their own technology, FATE succeeded in competing not only in the home market but also in the regional market.

The birth and consolidation of this enterprise, which in its day was the largest in the field of information technology in Latin America, clearly proved the degree of technological maturity that had been achieved, at the same time foreboding the country's early and successful insertion into informatics.

In 1976, the output of the three main companies amounted to 54 million current dollars, employing about 2400 people and generating exports for 41 million dollars. A single enterprise, FATE, employed about 80 professionals for R & D.

As for the area of computer products -minicomputers and mainframes- an open-door policy was implemented by applying the lowest import duties compatible with fiscal policy. Although the reasons underlying such policy were not explicit, it can easily be concluded that the authorities priviledged the need to modernize the country and create a market, over the possibility of achieving a higher technological and industrial standard. This may have been due to a lack of confidence in the country's capacity to reach the said standard in the short term.

Within the government, an Undersecretariat of Informatics was created, whose main task consisted in rationalizing and centralizing the projects on informatic applications issued by the various official bodies.

Table 2.1 shows the comparative dissemination of computers in Argentina at the end of the period.

COUNTRY	Nº of computers installed (units)	Value (Thousands of million U$S)	Nº of computers per million workers (rural workers excluded)
U.S.A.	170.000	34.0	1.847
Japan	39.000	8.1	829
West Germany	21.000	4.4	840
Great Britain	15.500	3.5	620
Canada	14.000	2.5	1.400
France	13.000	3.6	650
U.R.S.S.	12.500	4.5	121
Switzerland	2.300	1.3	920
Brazil	1.800	0.5	105
China	1.000	0.25	17
Argentina (1)	456	0.13	60
India	350	0.1	6
Taiwan	76	0.02	19
Sri Lanka	9	0.001	4

Table 2.1: Comparative view of universal computer installations (mini-computers excluded) in differente countries (1976 estimate)

Source: Estudio sobre el Sector de Computación y Máquinas de Oficina INTI, 1981

Based on 01 Hebdo Journal Nº 543, June 5th., 1979

(1) Own estimates, considering only 2,3,4,5 computer classes and 7.624.000 non-rural workers in 1976

2.2 - 1976 - 1983

There were no fundamental changes in the field of computer products, i.e., it was an open-door policy with either no customs duties at all or very low ones (5 to 10%).

The macroeconomic policy taken up in the first few years (1976-1981 - a revaluation and reduction of duty barriers) brought about a change in the relative prices between labour and imported capital goods, which resulted in a booming increase of the total amount of computers (a 65% increase in the number of machines installed in one single year - 1979).

On the other hand, between 1981 and 1983 there was a need for strong, frequent devaluations with the purpose of breaching the deficit gap in the balance of foreign trade, generating credit balances that would put the country in a condition to afford the accumulated foreign debt. The outcome of these measures was a marked recession. The computer market declined noticeably over the period.

The most significant facts characterizing the period are:

* A spread of local enterprises -both small and medium-size- marketing micro and minicomputers of various makes and origins. In the preceding period the trade lay exclusively with subsidiaries of multinational companies. According to a survey made in 1979, there were 50 enterprises in the field, most of them acting as sole representatives.

* A spread of software-houses marketing software packets, some of them of foreing origin and the others of their own writing mostly for business applications and writing software by request. Sixty five such enterprises, most of them small, were listed in 1979. The list did not include consultants working either individually or as a bureau.

* Close-down of the two industrial companies operating in the field of business machines (Olivetti and FATE).

It is very difficult to asses to what extent these events were a consequence of the policy adopted, or whether they were the natural outcome of international techno-industrial evolution.

It is clear that, over the period in question, the out-and out sustenance of an open-door policy no longer responded to the need for a market or to a lack of confidence in local technological capacity, which had already given enough proof of maturity, but to an ideological conception, that was against anything that might influence the market's free play.

During this period the legislation that protected national industry and national technological development was repealed restained or not abided by. This body of laws gave preferance to the official purchase of local products, demanded that local consultants should be engaged and, on the whole, encouraged the opening-up of technolrgical packages. Thus, government purchases were oriented towards turnkey systems.

More over, always through the turnkey system purchase method, there was a quick computerization process of the telephone state monopoly (ENTel), with the acquisition of stored program telephone exchanges, automatic collection and processing centers for repair requests, directory search systems, a packet-switching data-transmission network, etc. which turned the company into the country's largest user of information technology

2.3 - 1984 and after

In these few days after the installation of the newly-elected government, some decisions -both short and middle-term- have been made for the informatic sector, although they do not yet conform a policy.

The first measure, clearly a short-term one, meant for the present situation, consisted in an import ban on computers with memories up to 256 K bytes. The measure was not particularly directed to informatics, but it was part of a series of imports restrictions resulting from the need to generate a superavit in foreign trade. It comprises products which the country is already in a condition to manufacture. Taken in isolation, that is, detached from the context of a global informatic policy, it will surely save foreign currency and increase local added value, but it may have a boomerang effect from the point of view of technology-learning, since it gives indiscriminate protection to whatever form of industrial activity, thus indirectly favoring those activities that depend on foreign technology, which happen to be those that imply the least entrepreneurial risk.

At the same time, an interministerial committee was set up with the purpose of:

* Outlining alternative policies for industrial activity in Informatics and Related Technologies, determining suitable tools that will enable their execution.

* Outlining alternative policies governing informatic contracting and use in the public sector.

* Defining aspects of primary interest for a national development of informatic technology.

It is to be pointed out that this is the first time such a high-placed committee must give their views on public policies for informatics, having as their aim not only the rationalization and compatibilization of government purchases but also the regulation of national industrial activity and technological development.

Besides these significant actions, two additional measures have been taken:

* The government of Cordoba- one of the biggest federal states of the country- made an statement on the interest of the province on R & D, manufacturing and applications activities in the information technology field, and created a special commission whose aim is to translate that intention into specific actions.
* Three Ministries of the National Government (Defense, Education which comprise Science and Technology and Public Works) stablished an inter-ministerial commission for studying the creation of a National Electronic Center, which, on the basis of the PNE (National Electronic Programme, already existing) should coordinate the R & D activities of several laboratories and institutes performing a more executive role than the later and focusing those laboratories to the solution of specific problems presented them by the different official institutions and enterprises, taking so advantage of the purchasing power of the three ministries in order to drive the development of local manufacturing and know-how capabilities.

This set of measures could indicate that a certain level of maturity has been achieved on the awareness about the necessity of an official encompassing policy on the information technology and electronic field.

3.- NEEDS

The following is an attempt at summarizing what the authors feel are some of the country's prior needs in the field of information technology for which international cooperation could be useful. The list is tentative, and does not exhaust the subject. There is a second list including the mechanisms that may contribute to achieve the said goals.

A - Analysis and planning area

Aims

To improve the capacity to:

- Outline, select, supervise and evaluate technological and/or industrial development programs and projects.
- Interpret and carry out prospective technological studies.
- Select technological alternatives that are best suited to local conditions.
- Conduct and carry out studies on the social and economic impact made on the country by the new technologies.
- Evaluate methods, conditions and/or contracts for the transference of technology.
- Evaluate the externalities of a project.
- Analyze and survey local and international markets.
- Evaluate the quantitative and qualitative availability of human resources and plan middle and short-term educational needs.

Some implementation mechanisms

- Training of senior staff in specific areas
- Exchange of specialists.
- Attendance to conferences, seminars and tutorials by local specialists.
- Easy access to bibliograpgy and specialized literature such as: market research studies, technological forecasts, case histories, studies on other countries development, development projects of other countries, legislation in force in other countries, impact studies, reports on international trade, etc.

- Financing of national studies
- Carrying out and financing of multinational studies.

B - Application area

Aims

Improve the capacity to:

- Propose information technology application to non-traditional uses (hospital, rural, industrial, educational, etc) specifying the corresponding systems.
- Starting from the specification of a system, specify each of the sub systems and component parts, both hardware and software establishing criteria for dimensioning, costs, availability, compatibility, acceptance, etc.
- Secure and spread rapidly new technological applications that are evaluated as adapted to the local circumstances (e.g. CAD/CAM)

Some implementation mechanisms

- Training of senior staff in specific areas
- Training of intermediate staff
- Exchange of specialists
- Attendance to conferences, seminars and tutorials by local specialists.
- Financing of pilot projects for the implementation of non-traditional applications and/or the spread of new technologies.
- Potential local users working with advanced users from developed countries in order to investigate how new applications are being used.
- Easy access to hardware and/or software catalogues, reports on the availability of new products and technological prospectives, evaluation reports on advanced experiences, evaluation reports on hardware and software products and on systems, case histories, etc.
- Easy access to software packets or to software exchange with nations and/or institutions.

C - Human resources and R & D

Aims

- To improve the academic standard of higher studies, particularly as regards post-graduate courses.
- Encourage and carry out activities that imply creative or innovative development, including these in the curricula for the more advanced students.
- Set up software R & D programs for minicomputers and larger systems in university institutes and state laboratories.
- Increase own capacity for technological development of hardware and software, particularly by moving on to the field of 16 bit minicomputers and later on to that of 32 bit superminis.
- Increase R & D activities on communications (e.g. telephone and telex switching exchanges).
- Keep up and enlarge microelectronic activity through technological follow-up and pilot plants.
- Generate capacity of custom microelectronic circuits design to be processed eventually, on silicon foundries.

Some implementation mechanisms

- Grants to university lecturers and young professionals so that they may take up post-graduate courses.
- Systematic post-graduate courses and seminars with the assistance of foreign lecturers.
- Financing of equipments for university and research institutes.
- Training of senior and intermediate staff working for research institutes.
- Exchange of specialists.
- Attendance to conferences, seminars and tutorials by senior teaching staff and staff working for research institutes.
- Easy access to specialized literature.

- Financing of development projects that may take long before reaching maturity.
- Getting foreign institutions to contract development projects
- Carrying out of development projects jointly with foreign institutions.
- Financing of microelectronic pilot plants.
- Encouraging the repatriation of the argentinian researchers, engineers and technicians working abroad.

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