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# COMPUTERS FOR INDUSTRIAL MANAGEMENT IN AFRICA

## The case of Algeria

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## PREFACE

As part of its work on regional policy issues, the Regional and Country Studies Branch of UNIDO carries out policy-oriented studies and provides advisory services in key issues of industrial policy that affect groups of developing countries. This includes issues of economic integration, issues in the relationship between technological change and industrial organization and policy issues in international co-operation for industrial development. One area of analysis is the use of computers for industrial management in Africa. It focuses on the present levels of computer usage of this kind, and looks at the obstacles to a wider use. The study is intended to contribute to the development of technical assistance programmes and enhanced international co-operation in this field.

The management use of computers encompasses traditional applications such as payroll, accounts, stock keeping, etc. In other countries the computer has proved a useful tool in increasing the efficiency and accuracy of such tasks and contributing to the effectiveness of the management function. Its role in industry in Africa is potentially very important. However, obstacles to a wider use in Africa are many, and include both economic and technical factors. The study attempts to provide an overview of these.

As part of the whole study, several analyses are being made of individual African countries. The present study examines the case of Algeria.

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## INTRODUCTION

### 1. The industrial sector in Algeria

The main emphases of industrial policy in Algeria may be briefly summarized as follows:

- In the 1960s, policy was focused on the creation of national companies in the main industrial fields.
- In the 1970s the emphasis was on industrial integration. This strategy was based on about 15 national companies and on a centralized planning system. During the period 1967-1977 GNP growth was around 7 per cent annual average in real terms and the value added growth in the industrial sector was around 13 per cent.
- In the 1980s the emphasis was on the intensification of the industrial sector by creating small or medium companies, including in the private sector, which was also integrated in the national planning system. During the period 1980-1985 the GNP growth was around 5 per cent in real terms, and in the industrial sector there was an improvement in the utilization of installed capacities.
- In 1986-1987 the national planning system was adjusted to give more initiative to the individual economic operators.

Because of the oil price change in 1986, there was a reduction in imports and especially the raw material and semi-products imports of the industrial sector. This induced a slow-down of production and a negative growth in the economy excluding the oil sector (-2.5 per cent in 1987 and -3.4 per cent in 1988 in real terms).

The process of economic reform has now been accelerated, adjusting the planning system to give the maximum of freedom to the national companies. For these, strategy and management decisions are taken under the supervision of a council, with its members holding shares in the company and representing the state capital. The companies are free to decide on their investments, their management, trading, etc., as long as their financial management is good and the profits positive.

The planning system is now a decentralized one, organizing the economy mainly on the basis of market laws.

### 2. Computer utilization in Algeria

The Algerian state was one of the first developing countries to appreciate the important role of the computer in economic development, by initiating institutional development as long ago as 1969. Two bodies were set up:

- The "Commissariat national à l'informatique - CNI" (National Computing Organization) for promoting and developing the use of computers in Algeria;
- A national engineers school (at university level) for educating software and hardware engineers.

Subsequently, computer policy was extended to human resource development. Computing courses were introduced into secondary schools, high schools, and technicians schools, and many computing engineering schools were created in the main universities in Algeria (ten in 1989). An advanced stage has now been reached

with the launch of a national computer industry which will start producing microcomputers, in 1990, from a microcomputer assembly plant.

Under CNI, the Centre d'Études et de Recherche Informatique (CERI) was established in the same year, 1969. Four years later, in 1973, computer engineers were produced. CNI's main objective was to promote computing, and it played an important role, for instance, in the computerization of the Ministry of Finance.

To promote services and provide facilities, three regional centres were set up at the beginning of the 1980s. In addition, CNI became the centre for approval of all computer requests. Some studies for computer planning were also made. CNI had a monopoly of computing activity.

In 1982 an evaluation of the institutional framework was made, as a result of which CNI was split into:

- ENSI (Enterprise Nationale des Systèmes Informatiques) which is the means for executing national computing projects
- INI (Institut National Informatique) which is now one of ten
- a body within the Ministry of Planning for approval of plans and to authorize the issuing of import licences by ENSI.

Among the main achievements of Algeria's computer policy have been the following:

- Considerable progress in training and educating computing technicians and engineers to a high standard
- Use of computers in almost all economic sectors: transport, airlines, banks, post and telecommunications sector, large industrial companies, ministries and administrations, etc.
- Widespread acceptance of the need for computerization, with the concrete result that demand is a lot greater than supply. This is true both in terms of hardware requirements and the demand for computer services and especially software.

Some large computer services companies are found in Algeria, and the prospects for development of computer usage in the future are very good. There is one national informatics company (ENSI, which was created from the restructuring of the CNI), sectoral companies (agriculture, light industries, heavy industries, etc.), many district companies, and a number of private sector companies also.

### 3. The computer situation in 1989

The computer breakdown in Algeria in 1989 was the following (taking three classes of computers):

- around 40 large computers mainly from IBM, Unisys, Bull, Hewlett-Packard, Digital Equipment;
- around 350 minicomputers from about ten companies;
- around 10,000 microcomputers for professional use;
- around 10,000 home microcomputers from various companies.

These figures are derived from Ministry of Planning and ENSI, together with other estimates.

The total hardware value is estimated to be between 1 to 1.5 billion Algerian Dinars (1 \$US equals around 6 Algerian Dinars (DA) average 1989).

As noted, domestic production of computers was to be initiated in 1990. The existing stock derives from a number of foreign sources. The price of a computer is on average about twice the price in Europe because of transportation costs, taxes, etc. It is expected to fall with the initiation of production of microcomputers in Algeria.

Concerning computing services, the supply is mainly from Algerian companies. However, some foreign companies are intervening but on a lower scale and for specific sectors only.

As was already said, demand for computing greatly exceeds the supply of hardware, software and services. This is explained by the following considerations:

- the high level of education compared to the average for developing countries;
- the large numbers of university educated computing engineers and of technicians from specialized schools or secondary and high schools;
- the level of income which allows a number of Algerians to afford a microcomputer and standard packages;
- the strong links with Europe, mainly with France, and generally good knowledge of new developments in the field of computing.



## I. COMPUTER UTILIZATION IN ALGERIAN INDUSTRY

### I.1 Algerian industry

For the purposes of this study we principally cover three sectors which were in the beginning of 1989 the responsibilities of three ministries:

- the oil, gas, and hydrocarbons sector, including down-stream operations (chemicals and petrochemicals);
- the heavy industries sector: mines, iron and steel, mechanical engineering, electronics, electricity,....;
- the light industries sector: cement, textiles, leather industries, etc.

Recently these three sectors have been restructured into two ministries: mines and industries.

### I.2 Approach

For the present paper, data has been collected from a sample of industrial companies, and the remainder of the data has either been taken from the data available in the country (mainly Ministry of Planning and the national statistical office) or derived from estimates as necessary. Interviews and discussions were also held to complement this information.

### I.3 The hardware

For need of classifying computers, we have identified three sizes: mainframes, minicomputers and microcomputers.

The industrial sector is estimated to be using:

- 20 large computers mainly from the following companies: IBM, Unisys, Bull, Hewlett-Packard, Digital Equipment;
- 180 minicomputers (and multi-user microcomputers) from about ten foreign companies;
- around 3,000 microcomputers from various companies (including Wang, Siemens, Olivetti, etc.).

In general, large companies are using larger computers which are linked with minicomputers. The use of microcomputers in these companies can either be stand-alone, linked with other systems, or (especially) used as a terminal. The main large companies (all state-owned) include Sonatrach (oil), Sider (iron and steel), Sonelgaz (electricity and gas distribution), and SNVI (cars and lorries).

### Large computers

For the larger systems the main computers are from:

IBM	30 per cent
Unisys	25 per cent
Bull	20 per cent
HP and DEC	20 per cent, etc.

Medium size companies use either minicomputers and/or microcomputers.

### Minicomputers

For the minicomputers the suppliers are:

IBM	30 per cent
Unisys	15 per cent
HP	20 per cent
DEC	20 per cent
Bull	10 per cent
Others	5 per cent

### Microcomputers

Concerning microcomputers, the main supplier companies are:

Olivetti	10 per cent
Siemens	10 per cent
Wang	20 per cent
IBM	10 per cent
(PS/2 mainly)	
Unisys	25 per cent
Digital	10 per cent
Rest	15 per cent

Concerning the age of the hardware, estimates from various sources have been made:

#### For the large systems

35 per cent are less than 5 years old  
 50 per cent are between 5 and 10 years old  
 15 per cent are more than 10 years old

#### For the minisystems

50 per cent are less than 5 years old  
 45 per cent are between 5 and 10 years old  
 5 per cent are more than 10 years old

As for the microcomputers, almost all of them are less than 5 years old, due to the explosion in demand for microcomputers in very recent years. In the private sector, this kind of computer is the most often used because of the prices and the availability of standard packages for the general management of small factories.

Another interesting phenomenon is the trend of rapidly increasing computer usage, not only in the Algiers district, but progressively in almost all regions of the country, this being accelerated by the use of microcomputers.

If we compare how the computers were distributed between large, medium and small computers over the years, we can observe very great changes in the microcomputer share of all computers in Algeria.

In 1980 the distribution was as follows.

Large systems	12 units
Minicomputers and medium systems	110 units

In 1989, it had changed to:

Large systems	40 units
Medium systems	350 units
Microcomputers (including multistations)	10,000 units

Sources: Ministry of Planning, ENSI, estimates.

These figures do not include home microcomputers. This trend shows very significantly how the demand for microcomputers has grown and how widely they are used in very many fields of work, especially for small and medium size companies, including those in the industrial sector.

#### Computer maintenance

In the 1960s, foreign computer companies established in Algeria (mainly IBM, Bull and Burroughs) carried out maintenance of their products through direct contracts with their clients both for spare parts and staff intervention. At that time they were allowed to freely import the parts needed.

In 1978, a new foreign trade law allowed only national companies, not foreign companies, to import. From then on the foreign companies obtained their parts through a monopoly administration which was CNI (and ENSI when CNI was restructured into ENSI and INI) and carried out the maintenance using their own staff. The national company ENSI became a maintenance company for some of the computers installed.

Since August 1988, the above mentioned law has been abolished but the foreign companies are not yet allowed to import the parts. They can however import them directly through their clients if necessary and no longer through ENSI unless the clients want it. For the reasons mentioned, maintenance was not as good as it should have been, and the time taken for solving many computer problems was longer than expected. This negatively affected the companies and their productivity in general.

#### 1.4 Computer staff

In Algeria today, it is very easy to meet staff requirements for qualified computer engineers, which was not the case ten years ago. All those interviewed told us that they can find staff easily in Algeria and in almost all industrial locations. This holds for all the computer people needed: engineers, technicians, operators, etc.

The main problem is to find experienced people who have already worked in the industry and can lead others in carrying out medium or large computer projects.

Because demand is greater than supply, and because the salary scale is a national one, (so that one is paid more or less the same wherever one is working) those who have some experience in a large or medium company tend to move to a smaller one, in order to be promoted to a higher level and thus receive an increase in salary. The other option for such computer staff is to work in the

private sector where they will get higher salaries. This trend has had a beneficial effect in making a wider diffusion of computer people over companies and regions. Thus it is easy to find computer people in the small companies which was not the case ten years ago. But, on the other hand, large computer services companies are losing their experienced people and are starting again with beginners.

Table 1. Computer staff at 31 December 1986

	In Algeria	In the industry
Engineers and project analysts	2,200	800
Programmers	800	350
Operators and data entry clerks	3,000	1,100

Source: Ministry of Planning and estimates

Table 2. Additional computer staff needed for the year 1988

	In Algeria	In the industry
Engineers and project analysts	1,050	300
Programmers	280	100
Operators and data entry clerks	750	200

Source: Ministry of Planning, and estimates (based on requests to Ministry which were required at that time)

### Education and training

Most computer staff are educated and trained in Algeria. Some have obtained post-graduate qualifications abroad but their number is very small. In general, these would obtain an Algerian engineer diploma and go abroad for specialization studies.

In 1987, the ten universities in the country produced 335 computer engineers and it is expected that this number will rise to 500 in 1990 (source: Ministry of Planning).

Programmers are trained either in specialized centres or by taking a computing specialization in the secondary and high schools.

Operators are usually trained by the companies themselves or sent to the computer company from which the computer is bought.

The following table is shows the source of computer training.

Table 3. Training for computer staff

Training	Internal training	Computer company	Algerian university	Abroad
Engineers			95%	5%
Computer analysts	10%	10%	80%	
Operators	70%	30%		

Source: Estimates from various sources.

### I.5 Software and computer applications

Almost all industrial companies (state and private) have their systems computerized.

In general, the larger companies develop their own systems and the others, the medium and small ones, use standard software packages. The latter may however also have their systems developed by services companies or, if equipment is not available, they may have the processing of their standard systems carried out by computer services companies.

The most frequently used systems are:

- general accounting
- payroll

for almost all the companies (first set of systems).

Usually, these are batch systems in the large and medium size companies, and standard packages for the small ones, which generally use microcomputers in a conversational mode.

There is a second set of companies that additionally use:

- invoicing systems
- inventory and stock management systems.

These are about 50 per cent of the large and medium size companies, which have developed these systems themselves.

A third set of companies additionally use:

- purchasing systems
- production control systems
- maintenance systems.

This set comprises very few companies, all of which are large ones. In general, they have developed their systems themselves, and have started work on these some years ago.

In a fourth set of companies we find some companies which have done one or more of the following:

- developed on-line or conversational systems;
- developed quality control systems;
- developed some specific systems such as management accounting systems.
- are using process control computers, etc.

To summarize, we have the following table:

	Number of companies in total of industrial companies
First set of companies	95%
Second set	40%
Third set	20%
Fourth set	10%

Source: Estimates.

Concerning development of their own systems of the industrial companies, we have the following table:

	Own development	Packages or outside development
Small companies	20%	80%
First set of companies	60%	40%
Second set of companies	70%	30%
Third set	80%	20%
Fourth set	90%	10%
ALL companies	70%	30%

Source: Estimates

We can see that the number of companies which develop their systems themselves is large. On the other hand, small companies generally use standard packages.

The number of companies that are very well computerized, in the sense that they have a number of systems covering their various fields of activity and they are using computers both in their central offices and in their decentralized location, is very few. Generally, we find more and more on-line systems concerning the second, third and fourth sets of companies. The first set of companies in general uses batch systems.

If we compare the previous table with other sectors outside the industrial sector, we have the following:

industry own development	Other sectors own development
70%	55%

This can be explained by the fact that, historically, the industrial sector had a level of development higher than the other sectors, for which growth took place only in the 1980s. Another explanation is the use of standard packages for microcomputers, which have been used on average more in non-industrial sectors, these having started computerization later than the industrial sectors.

#### 1.6 Telecommunications network

Only a few companies are using the national telecommunications network for computer purposes. Although local computers networks exist here and there, the use of telecommunications lines between regions is small in the industrial sector. This is for two main reasons:

- The telecommunications network is not sufficiently developed, and the Post and Telecommunication Administration has only recently started to implement a reliable network;
- The level of use of computers in industry is not sufficiently developed, as compared for example to computer usage in the banking sector or by airlines,

#### 1.7 Environment

Except for a few days in the year and for the south of the country, the climate is moderate. However, in the north of the country humidity is high and dust is everywhere.

Almost all the medium and large companies have appropriate equipment to meet these conditions and few problems arise from them. For the smaller companies generally using microcomputers, problems arise more frequently.

The power supply (public electricity network) is good in Algeria and electricity is stable in general. There are occasionally some cuts, but they are very few and not in the areas where industries are located. However, large and medium size companies have in general the necessary equipment and do not suffer problems arising from the electricity supply.

## II. PROSPECTS FOR COMPUTING AND RELATED ASPECTS

### II.1 Trends in the computer utilization and related aspects

The Algerian computer situation, although better than average for developing countries, still has several areas where improvement is needed:

- In comparison with the real needs of each company or sector, computer usage is not high enough
- There are weaknesses in software development and in the use of standard systems and there are not enough specific systems adapted to each sector or activity.

The next proposed national computing plan will cover a five year period and has two overall objectives:

- to achieve a computer development that is adapted to economic development;
- to take advantage of the economic reforms giving more freedom to the national the companies and including the development of the private sector.

This plan contains the following elements of the computing strategy:

- A growing role for computing in the state administration as well as for every sector or company;
- Assembly of computers to save imports;
- Greater use of microcomputers, being less expensive than minicomputers and large computers and increasingly powerful;
- Improvement of computer services, especially by developing and creating services companies to meet local needs;
- When possible, export of software and services.

Hardware demand is expected to be twice in 1994 than the current 1989 demand. This trend will hold for terminals, printers, modems, multiplexers, standard packages, diskettes, magnetic tapes, spare parts, etc.

The expected local production from the microcomputer assembly plant will be both for the local market and for exports. The joint -venture company Alphatron will assemble computers in Oran in the third or fourth quarter of 1990. The construction is complete and technology and equipment will be acquired soon. In fact Algeria already had some experience in this field, because CNI used to assemble computers, VDUs and printers.

Concerning telecommunications, the Post and Telecommunication Administration will start implementing in 1990 a telecommunications network of the French Transpac type.

These two major steps will be accelerating factors for computing in Algeria.

#### Services

The demand for packages and applications systems for the user (accounting, payroll, inventories, invoicing system, production control, etc.) applications dedicated to special companies or sectors (transportation, banks, insurance, local administrations, etc.) and for services upstream (organization, software houses, etc.) and down-stream services (training, maintenance, computer sales, etc.) is very important.



This demand is especially important for some companies or sectors where the use of computers is nowadays essential and where the level of usage is insufficiently developed (banks, insurance, some industrial companies, etc.).

This demand is concentrated particularly in the following areas:

- large companies and government ministries, where computing development has been uneven but where a certain computing infrastructure exists, with a computing committee, services companies by sector, and regional services companies for developing computers systems in these organizations;
- small and medium size companies not yet organized in computer terms but for which the use of computers will be an important demand. These companies will mainly be looking for complete solutions (hardware, software, training, maintenance, etc.)

To consider another aspect, the regional distribution of computers is roughly the same as that of the economy itself, where about 80 per cent of the demand is concentrated in the northern part of the country, the southern part being mainly desert.

Decentralization in the Algerian economy will have as a consequence, in the medium term, a wider distribution of computers throughout the country, with a growth in the east and the west and a small increase in the south also.

The main computer services required are:

- organization, studies, software development
- computer processing, data entry
- sales of packages (general and specific)
- training
- application systems development
- hardware maintenance
- sales of computers, diskettes, tapes etc.

Rapidly increasing demand will be seen for computer training, applications and software development, and computer sales including maintenance.

Additionally, it can be expected that there will be rapidly growing demand for complete solutions for microcomputers.

Demand will be particularly strong in some sectors or companies for which the development of computer usage has been very slow, including the following among others:

- hospitals and health sector
- schools and universities
- construction
- local administration

It is estimated that demand for services will grow very rapidly during the period 1990-1994, more quickly than the demand for hardware.

The available services supply consists of the services departments of the companies, administrations and organizations, and also service companies both from the public sector and the private sector.

At the moment, the public sector is the more important of these in the field of computer services, with one national company, around ten sectoral companies and around fifteen district companies.

The private sector is made up of small companies, which, however, are both very aggressive and efficient. The number of companies is still small but it is growing.

The local agencies of international companies (IBM, Bull, Unisys, Hewlett-Packard, Digital Equipment, etc.) provide services mainly in the fields of software and hardware maintenance. Some foreign companies intervene very marginally for organization, some studies or some software implementation.

The services supply is estimated to be growing very rapidly because:

- It is mainly based on local recruitment, and, as will be seen later, the education system is scheduled to produce numerous technicians and engineers in the near future;
- The share of services expenditure in total computing expenditure is expected to grow very rapidly in Algeria in the coming years.

## II.2 Manpower, education and training

### II.2.1 Manpower

To meet the growing market requirements, there are specific requirements both in quantity and quality for human resources.

Part I of this paper referred to the numbers of computer staff at present engaged both in the industrial sector and in the economy as a whole for the year 1986 as well as the estimated demand for 1988. As noted, in the next few years, manpower demand is expected to grow very rapidly in the services departments or services companies, more than in the hardware departments or hardware companies.

Taking "computer engineers and project analysts" as one category of staff, their number in 1994 can be expected to be between 2.5 and 3 times the current 1989 figure.

Concerning programmers, the demand for these will continue to decline, since, in the future, fourth generation languages, data base packages, etc. will be more and more used. Users will increasingly be making their own programmes especially simple ones, while more complex ones will increasingly be written by specialists mainly engineers. In this connexion the evolution in the kind of education given to technicians and "superior technicians" is discussed below.

Concerning operators, this category of staff will continue to exist and will grow with the number of computer centres, especially for the large computers.

On the other hand, the future numbers of data entry clerks will be as difficult to predict as those of programmers. The growing number of microcomputers and interactive computers is such as it is very difficult to separate between data entry and processing for the usual systems. Of course, for creating and updating big data banks, data entry will be again needed, but increasingly, part of the usual data entry for the usual systems (accounting, payroll, etc.) will be shifted to the user side, thus diminishing the data entry load.

## II.2.2 Education

Education is a fundamental factor in computing development, and this section reviews the state of the computer education and training from the high school to the university and after.

### Primary school

Some years ago, experimental use of computers in primary schools began in pilot schools. This experiment is still continuing. For the future especially the cost of computers will further decrease and an extension to other schools can be foreseen.

### High school

Some years ago the teaching of computing was initiated in some high schools distributed over the country. At the end of the high school course, there is an examination for a computing baccalaureate. In 1989 there were 80 high schools giving such courses.

In addition, a computing option exists within the management option.

The main objectives are:

- To increase the numbers of those holding a computing baccalaureate that will be recognized for job applications,
- to increase the numbers of those with initial knowledge of computing that can serve as the basis for further studies at university level.

### Education for "computing technicians"

For those pupils who have not obtained the baccalaureate, there exists since 1984 an education called "Professional training" which leads to the diploma of "computing technician". Because of competition, demand for this education is very great although the number of "Professional training centres": is increasing every year and located all over the country. Pupils learn programming in many languages and undertake general studies in computing, computer projects, etc.

There is a definite demand for the computing technicians in the employment market and their education is appreciated, although they need more practice and computer experience. There are 3-10 schools for this purpose distributed around the country.

### Education for "Higher technicians"

After the baccalaureate, the universities produce "Higher technicians" after a five semester course.

In general, two options exist:

- computer maintenance
- information systems.

The courses are mainly practically-oriented. In the last semester, students are invited to prepare a practical project.

This kind of education has met with a good reception and the higher technicians are much needed in the market.

They are usually employed as analysts, system analysts or project analysts.

### Education in the universities

As we have already said at the beginning of this paper, the first university school producing computing engineers or scientists opened in 1969.

Since then computing education in the universities has evolved greatly and now there are ten university institutes specialized in computing, covering all the regions of the country. The purpose of these institutes is to produce engineers, higher technicians and specialized staff, especially in management and organization.

During the university year 1988 - 1989 the total number of students in these institutes was estimated at around 5000.

### Computer engineers education

The computing state engineers have a five years training period.

The number of applicants for this specialization is considerable. For that reason, after the baccalaureate, a selection examination is made in order to select the number of students according to the availability of place in each institute.

Two options exist starting, starting with common courses in the beginning:

- Systems (hardware and software)
- Information system and organization.

After the diploma of engineers, students either take up employment or continue their studies at the master's level.

This form of education of engineers seems to meet the needs in Algeria and at the moment the companies find it very satisfactory. Even foreign companies such as Unisys, Bull, etc. find this level of education sufficient for their needs.

### Education in computing outside the computer institutes

In the university, in almost all specializations, courses on computing are introduced, for instance in medicine, economics, social sciences, physics, chemistry, etc.

At a minimum there is a general introduction to computing, using computers according to their availability.

In technology, courses on computing are very important, especially for students on electronics, electrotechnics, etc. These courses cover computer programming, operating systems and other topics.

### Postgraduate education

For research purposes but also for educating teachers in computing, there are two levels of post-graduate education in computing:

### Master

Theoretically, a master's degree takes two years. is prepared in two years. The first year covers computer science at a more detailed level, and there is also a research component, where the student prepares a thesis. Usually students who are allowed to do a magister are either selected by examination or because of very high performance.

However, the experience of the master's degree in Algeria shows that:

- Few Algerians have the necessary level for teaching at this level
- there is a mixture of foreign and Algerian teachers with a lack of co-ordination in the courses;
- Teaching takes place mainly in French

### Doctorate

Usually, for this level, students are sent abroad. They can also carry out research under the supervision of a professor from a foreign university and work on their thesis in Algeria, travelling from time to time to visit their professor.

There are problems facing students at this level when they return home, including housing problems, difficulties in finding suitable working conditions, salary, etc.

#### II.2.3 Computer training

Apart from the national policy of education in the primary, secondary and high school, and in universities, there are other companies and organizations public and private which give courses in relation to the use of computers.

They are usually user-oriented and are specialized either in very practical courses or in courses for people who are already working in companies and not in a position to attend school or university.

Additionally, some courses are also oriented to the use of computers for management or organization.

This gives an opportunity for computer staff to keep themselves informed of the latest developments, as well as for users to become more acquainted with the use of computers.

In conclusion, apart from the areas of very high level staff and specialized staff, there are sufficient levels of education and training for computing in Algeria.

#### II.3 The environment for computer usage

Concerning the environment, apart from briefly mentioning climate and electricity, there are two important problems to be stressed:

- computer maintenance
- prospects for the telecommunications network.

### Climate

As already stated, the climate is generally moderate apart from the southern part of the country and a few days in the year in the northern part of the country where the main economic locations are concentrated.

For this reasons, air conditioning needed is almost the same as in countries such as Spain or Greece. Usually, the necessary equipment is to be found but is imported, with payment in hard currencies.

### Electricity

Algeria is very well supplied with electricity and the electricity network is very wide. Almost all locations have electricity and electrification in the future will be higher.

For that reason, apart from some very rare cuts, because of storms or such reasons, the electricity supply is very stable. The normal surge suppressors and regulators found in developed countries should be used. Surge suppressors are already assembled in Algeria and will be increasingly produced.

### Maintenance

The spare parts question is closely linked to that of maintenance. The previous conditions for the import of spare parts have already been described, including the economic regulations and especially the law of foreign trade of 1978. With the new regulations the prospects are brighter for imports of spare parts.

Many solutions are now possible with new regulations, such as:

- imports by the user through the user's computer company
- imports by a national company for groups of users

With the solution of the problem of spare parts, which it is hoped will have been completed by 1990, maintenance competition will be possible between national companies, foreign companies and the Algerian private sector.

In the field of software, another problem is that of new versions of operating systems (new releases). This problem is almost the same as the spare parts problem, because again the foreign company may import the new releases on behalf of the user or an national company can do it for groups of users, etc.

Thus the prospects for software and hardware maintenance are positive and this will be important for efficient computer usage and thus the general productivity of the economy.

### Telecommunications network

Up to now, to use telecommunications with terminals and computers, there were the following possibilities:

- the telex network connected to the international network which allows data transmission at low speed (up to 200 baud);

- the normal telephone network which is undergoing big changes at the moment in Algeria, using digital techniques both in transmission and commutation. However, until these changes are finalized, the problem of noise is still present both in local transmissions and between regions. With the new changes, the telephone network will be used for telecommunications between computers but only to a certain degree;

- specialized telephone lines exist for some users although their cost is expensive and they cannot allow transmission to other users. They are used by some banks, airlines, etc., because of the lower noise than the normal telephone network;

- the public data network using "circuits commutation" installed in 1987 has allowed some users to be connected and use this network with a speed between 2400 and 9600 baud. Only a modem is needed for connexion. Around 300 users are connected or being connected to this network in 1989.

For 1990, the Post and Telecommunication Administration has planned to install all over the country a public data network (packets switching) of the Transpac type using:

- standards X 25 and X 32 from 2,400 baud to 48,000 baud
- standards X 28 from 50 to 19,200 bauds
- connection through the telex network
- connection through the telephone network
- connection through specialized telephone lines
- international connection.

Tariffs will be related to data transmitted, to the access mode to the network, and to the speed of transmission. This network and associated services will be an important factor in the accelerated use of computers throughout the country.

In relation with this network development, there will be increased requirements for specialists in telecommunications, with consequent implications for university education.

Service companies will be required in order to develop value-added services induced by the new network and the new needs of data transmission.

Development of data banks and data access will be also accelerated for various needs, such as economic data, bibliographic information, university networks, and specific individual needs.