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MONOGRAPHY

THE ELECTRONIC SECTOR IN MOROCCO

PRESENT SITUATION AND PROSPECTS FOR GROWTH

SEIFEDDINE BENNACEUR

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GLOSSARY OF ABBREVIATIONS

| | |
|-------------|--|
| BIOS | : Basic Input Output System |
| CAD | : Computer Aided Design |
| CKD | : Completely Knocked Down |
| DH | : Dirham of Morocco |
| DIP | : Dual In Line Plastic |
| FST | : Flat and squared corner screen Television |
| GDP | : Gross Domestic Product |
| IC | : Integrated Circuit |
| IMF | : International Monetary Fund |
| M \$ | : Million US \$ |
| NIC | : Newly Industrialized Countries |
| ODI | : Office pour le Developpement Industriel |
| PAXB | : Private Automatic Branch Exchange |
| PC | : Personal Computer |
| PCB | : Printed Circuit Board |
| PLC | : Programmable Logic Controllers |
| RAM | : Random Access Memory |
| SB | : The author of this report |
| SC | : Semi-conductor |
| SKD | : Semi Knocked Down |
| UPS | : Uninterruptible Power supply |
| VA | : Value Added |
| VAT | : Value added Tax |
| VCR | : Video Cassette Recorder |

PART ONE THE GLOBAL SITUATION

Morocco is located in North Africa and has a population of about 22 millions (equivalent to Algeria and three times Tunisia). The GDP per capita was 567 \$ with 3.3 % of average increase rate between 1979 and 1986.

Morocco became independent in 1956 and started its industrialization in the early 60s but the real start was in the five years plan 1973-77 with a strong policy of import substitution and capital investment. The rate of growth of the industrial sector was much higher than the one of GDP. It resulted from that a large increase of manufactured products imports and a major financial effort.

The drop of international prices of phosphates (Morocco is the World Leader and Phosphates are its first export resource) and the Sahara War, led to an austerity plan in 1978-80 with almost everywhere negative growth rates. The external debt grew very quickly: in 1975, the ratio Debt/GDP was 20%, in 1980 it reached 52% and 190% in 1986. The debt service reached 70 % of exports and this high level forced the Moroccan Government to re-negotiate its debt in 1984 and in 1986.

The IMF and the World Bank put hard conditions to their financial help which started in 1983:

- increase of public expenses in Public Services, Health and Education. The extension of school education (Second and Third Degree) was slowed down.
- liberalization of external trade and introduction of VAT in 1985. More than 80% of imported goods has no more restriction on.
- devaluation of the Dirham and decrease of custom tariffs

This policy of austerity is starting to pay. With the help of good crops, low oil prices, tourism, exports of industrial products and increase of emigrants remittance, the Balance of Payments should be equilibrated in 1988.

The local currency is the Dirham which is worth:

$$1 \text{ DH} = 0.71 \text{ FF} = 1.23 \text{ \$} = 0.21 \text{ DM}$$

The minimum wage for a worker is 1000 DH/month and the average engineer earns 5000-6000 DH/month.

Morocco is an associated member of the EEC which is the main partner (39% of imports and 49% of exports). The entry of Spain and Portugal into the EEC is a serious problem for the local agriculture and Morocco was candidate to join the Common Market.

In the manufacturing sector, Food Textile and Chemical industries are by far the most important sector with 66% of added value and 85% of exports. Engineering Industries share is very low even compared to similar countries.

The following table gives some basic indications for Morocco in 1986 and their origin is mainly the World Bank publications. The official figures in Morocco for area, density and population are different because of the former Spanish Sahara:

Area : 700 000 km²
Population : 22.7 millions
Density : 32.4 hab/km²

TABLE 1 - MOROCCO - BASIC INDICATORS IN 1986

| | | UNIT |
|----------------------------------|-------------|---------|
| AREA | 447 600 | km2 |
| POPULATION | 22 500 000 | Hab |
| DENSITY | 50.3 | Hab/km2 |
| TOTAL GDP | 13400 | M US \$ |
| GDP PER CAPITA | 567 | US \$ |
| AVERAGE GROWTH RATE 79-86 | 3.3 | % |
| BRAKEDOWN OF GDP IN 1985 (1965) | | |
| - Agriculture | 18 (23) | % |
| - Industry | 32 (28) | % |
| - Services | 50 (49) | % |
| Inflation rate 80-85 | 7.8 | |
| MANUFACTURING ADDED VALUE | | |
| - Agro-food | 35 | % |
| - Textile | 21 | % |
| - Machinery and Transport | 4 | % |
| - Chemicals | 10 | % |
| - Others | 30 | % |
| IMPORTS | 3801 | M US \$ |
| EXPORTS | 2437 | M US \$ |
| EXPORTS/IMPORTS | 64 | % |
| BALANCE OF PAIEMENTS 1985 (1970) | -889 (-124) | M US \$ |
| DIRECT FOREIGN INVESTMENT | 20 | M US \$ |
| EDUCATION % of the class of age | | |
| - 6-11 years | 56 | % |
| - 12-17 years | 44 | % |
| - Third degree | 8 | % |
| - Literature rate | 33 | % |

Source : The World Bank

PART TWO THE ELECTRONIC SECTOR AND ASSOCIATED SERVICES

I. GENERAL DESCRIPTION

Started about twenty years ago, the Electronic Sector was quickly diversified. The first company was created by a French Multinational to take advantage of the low wages and to package integrated circuits. This company (SFRM) has always been the biggest employer of the Sector and manufactures also communication equipment for the local market.

In the early 70s, many Consumer Electronics Companies were created working with CKD bought under license from major European manufacturers (Philips, Thomson) and Japanese (Hitachi, Sony).

Later, many independent subcontractors were started and they are mostly formed in association between local investors and European (mostly French) companies.

Morocco has a major difference with its neighbours: it did not insist very much on the replacement of foreign management teams by nationals and many companies still have many foreign managers and engineers. This aspect is of course less strong than it was few years ago as native engineers were educated.

The country has also very good capabilities in trade which has not only advantages in the industrial field as many companies have a very limited assembly activity: a plant can be started because there is a big contract for the administration and then turned off as the contract ends.

In 1975, there was only eight companies employing 1200 persons and from 1975 to 1978, fourteen companies, most of them in Consumer Electronics, were created.

From 1978 to 1986, eight companies were started beside the twenty-two which already exist. The total employment raised from 2900 to 3900 and total sales from from 29 to 90 M\$. The evolution is described in table 2.

TABLE 2 - EVOLUTION OF THE ELECTRONIC SECTOR IN MOROCCO

| | 1975 | 1978 | 1986 |
|---------------------|------|------|------|
| Number of companies | 8 | 22 | 30 |
| Employment | 1200 | 2900 | 3900 |
| Sales (M\$) | 17.0 | 29.0 | 90.0 |
| Added Value | 4.5 | 6.8 | 22.0 |

Sources : ODI, SB

Today, the biggest company, SFRM employs 2000 people, mainly basic workers and its case set to us a methodologic problem. The activity of this company is in semiconductor packaging and it is a subsidiary of Thomson to which it sells a subcontracting service calculated in hours of workers. This means that the sales of this company are not evaluated normally and with more than 50% of the sector employment, its sales are only 20% of the total sector sales. A correct evaluation of the Electronic Sector total sales would be between 130 and 140 M\$ in 1986.

Most of Moroccan companies are small sized as the following table shows.

TABLE 3 - BREAKDOWN OF ELECTRONIC COMPANIES BY SIZE IN 1986

| Size | Number of companies | Total employment |
|--------------|---------------------|------------------|
| > 2000 | 1 | 2000 |
| 250-2000 | 0 | |
| 100-250 | 6 | 770 |
| 50-100 | 11 | 790 |
| < 50 | 12 | 340 |
| TOTAL | 30 | 3900 |

Source : ODI

The breakdown of electronic activities by main sub-sectors is typical of many starters in developing countries: consumer goods and components mainly subcontracted for foreign firms are the most important.

TABLE 4 - EVOLUTION BY MAIN SUB SECTORS

| | Number of companies | | Sales | | Employment | |
|------------------------|---------------------|-----------|-----------|-----------|-------------|-------------|
| | 1978 | 1986 | 1978 | 1986 | 1978 | 1986 |
| Components | 5 | 11 | 2 | 23 | 850 | 2300 |
| Industrial Electronics | 2 | 6 | 5 | 11 | 250 | 400 |
| Consumer Electronics | 15 | 13 | 22 | 56 | 1800 | 1200 |
| TOTAL | 22 | 30 | 29 | 90 | 2900 | 3900 |

Source ODI (1986), SB (1978)

From Table 4, many trends can be drawn. Employment has decreased by one third in Consumer Electronics and increased by almost three times in components. The increase in Industrial Electronics employment should be tempered by the fact that after 1986, two major Tele-communications Companies have strongly reduced their personnel.

The disproportion in sales and employment figures between Consumer Electronics and Components is due to what we stated earlier: Consumer Electronics have a small Added Value (less than 20%) and Components Firms have a very big one (70%) but they employ mainly very basic workers.

The share of Electronics Industries in the Moroccan Industries is very small: 0.25% of employment, 0.5% of Added Value which is smaller than many developing countries. This also means that the specialization in Electronics is very low compared to Textile or Food Industries. Table 5 gives some comparative data such as % employment in the Electronic Sector/Total Industrial Employment and the same ratio for Value Added.

TABLE 5 - SHARE OF THE ELECTRONIC SECTOR IN THE INDUSTRY OF SELECTED COUNTRIES

| | Population (millions) | GDP \$ per capita | %Employment | %VA |
|----------|--------------------------|----------------------|-------------|-------|
| Morocco | 22.5 | 567 | 0.25 | 0.52 |
| Tunisia | 7.5 | 1201 | 0.37 | 0.56 |
| Korea | 41.0 | 2150 | 5.90 | 8.80 |
| Turkey | 50.2 | 1173 | 0.59 | 1.22 |
| Thailand | 52.3 | 821 | 0.69 | 1.20 |
| Taiwan | 19.6 | 3701 | 8.57 | 12.00 |

Sources: ODI (Morocco), API (Tunisia), World Bank and various market studies

This table shows that electronics is proportionally less developed than in countries which put a big stress on electronics such as Korea and Taiwan.

II. SUB SECTORS ANALYSIS

The situation of the companies working in this field is very difficult in each sub-sector. We will analyze hereafter the main salient features of these companies.

I. Components

Seven companies operate in this sub-sector: the largest one (SFRM) with 2000 workers and six small companies working mainly in subcontracting.

The first one was started by Thomson (France) to work in two fields: assembly of radio-communication equipment mainly for the local market and packaging of components as a back end plant of French Factories of semiconductors. In this second activity, there is no very high volume IC with standard plastic packaging such as 14, 24 or 40 pin DIPs. It is a more specialized and less high volume type such as power transistors, power IC and hybrid which is a difficult and sensitive packaging area.

The mother company wishes probably to keep this activity and its Know How under control and it is a fact that packaging firms in South East Asia do not work very much out of the big volume type.

There were many discussions inside Thomson to decide whether this activity should be transferred to Singapore or Philippines or not as wages are appreciably higher in Morocco and industrial infrastructure not as good as it is in the Far East.

Finally it seemed that the Moroccan operation was running smoothly, with a very good productivity, hard working employees and a valuable geographical proximity. The employment of this operation has been increased and its size is comparable to what it is in Malaysia or Philippines. A few years ago, there was a trend to re-locate back end plants in Europe with a very high level of automation and one of these plants was built in Eastern France but its economic conditions never succeeded to reach those of Morocco specially after the 40% devaluation of the Dirham.

The future of this plant depends now on the new direction taken by STC, the merger between SGS (Italy) and Thomson which had separate back end plants (in Malta and Singapore for SGS).

The second activity in components is in Printed Circuits where three companies operate. The first one was established within a compensation agreement with a French car manufacturer. It is working well today and with 40 people, most of the production is exported (single and double sided).

A second company, a joint venture between French and Moroccan investors seems to develop quickly its activities with more modern equipment.

Moroccans claim that their operating costs can be as low as Taiwanese and Korean: it is probably true specially for small batches.

A few other companies of comparable size, owned mainly by natives manufacture various types of mechanical components (Transformers, custom made Cables) and some other subcontract board-level assembly and control.

There is an interesting case of a local industrial group that started specialized subcontracting firms with modern methods and tools that seems to do very well.

There is also a very dynamic company that manufactures various types of antennas, amplifiers for these antennas, components such as transformers and voltage regulators. It started with technical and marketing agreements with a German Company and became progressively independent and has a good technical know how in the field (100 people, 4 M\$ of sales).

It seems that these companies are well integrated in their industrial environment which is not the case in many countries (cf Tunisia) and there is a good flow up stream (in basic manufactures) and down stream these companies. There is also decreasing technical and marketing dependence on foreign associates which means that natives learned how to produce and how to sell inside and outside the country.

2. Industrial Electronics

2.1 Communications

Tele-communications Industry used to employ about 300 people in three companies but it was mainly an extension of commercial activities of subsidiaries of foreign companies (ITT, CGCT): the operations were assembling mostly electro-mechanical switching systems, Tele-printers and telephone sets for the local market with a very low (if not negative) added value.

The situation is rapidly evolving today as the Tele-communication Policy is under study: Morocco is poorly equipped and its public network is saturated.

The number of lines per 100 inhabitants is one of the lowest in the Arab World but Digital Public Switching has been introduced in early 80s.

TABLE 6 - INSTALLED TELEPHONE LINES IN SELECTED COUNTRIES

| | Installed lines | %Digital | Lines/ 100 inh |
|---------|--------------------|----------|-------------------|
| Morocco | 280 000 | 45 | 1.2 |
| Algeria | 750 000 | 2 | 3.3 |
| Tunisia | 305 000 | 44 | 4.1 |
| Egypt | 1 300 000 | 9 | 2.6 |
| Kuwait | 530 000 | 62 | 29.6 |
| Qatar | 106 000 | 88 | 32.1 |

Sources: Various market studies

This means that the potential market is huge and if the country wants to reach an honourable 5 lines/100 person, it has to install around 1 million lines. Two or three years ago, such a plan was in the air (an international tender was issued with many hundred thousand lines) but it has to be strongly reduced because of economic problems.

In Radio-communication, SFRM has been producing professional equipment for many years and it supplies about half of the local market mainly for defense and police needs.

For the total sub-sector, about one third of the local market is covered by local production.

2.2 Data Processing

In 1985, a Company producing Personal Computers and accessories was established as a joint venture between a small French Company (stopped in 1987), a local Software Company and the ODI (Office pour le Développement Industriel), a Moroccan State Agency.

This Company (I.I.I.) intended to manufacture PCs under license and to design boards and accessories. It concentrated its design on bilingual applications (Arabic and Latin) and came with a few text and Graphic Adaptors working in Arabic and Latin and were successful in this area. The French associate had various problems, stopped its manufacturing activities and started buying Taiwanese boards before going bankrupt.

The association was quickly stopped and I.I.I. started buying components and boards from the Far East and from the USA. The present production is from 500 to 1000 PC configurations per year and many contacts are being taken to export to countries in the area. It has 20 to 30% of Market Share for PC. It has 30 employees from whom 17 are engineers which is an unusual rate in Morocco.

Another small company was started recently but we could not have precise information about it.

Many International Companies have representatives and the number of brands is impressive for such a small market. These representatives usually run also a software company or department. There are about 70 service companies doing representation, software. The average number of persons is five with two firms which have more than 50 people. The largest one is IMAG which is the Mother Company of I.I.I. and it has 100 employees and a good technical level.

There are no public institutions for software and hardware certification, as there is in Tunisia and Algeria, and the Government thought three years ago about establishing a sort of National Data Processing Center but everybody in the profession fought against this idea and this Center was not carried out.

There is an intense situation of competition with many one or two persons Companies that have not real.y professional qualifications and serious Companies are beginning to dominate the Market as users start to understand how to look at a price.

2.3 Automation

Manufacturing of automation products is limited to the assembly of Contactors and circuit breakers which are generally classified with electro-mechanical products.

There are two companies designing and installing control panels and a few representatives that have a small activity of programmable controllers programing. Maintenance is done by the companies that designed the plants, and they are generally foreign which sets a financial problem.

The largest end users have generally a good level of know how in running the installation but few of them have invested in plant design know how.

The more we go toward engineering, process know how, process control design, the less we find a local content of automation activities. As there are no local companies for high level automation , there is no accumulation of know how even in the areas where Moroccan Industries have a good strength i.e Textile, Food, Chemicals.

Morocco has succeeded to attract Boeing to locate its Regional Maintenance Center in the country. In exchange, the National Airline Company, RAM had to buy only Boeing airplanes. This maintenance shop seems to have a good size with many Moroccans and foreign employees. We could not have any figure about the size of this activity, but we think that it gives many benefits to the technological level of the country in this field.

3. Consumer Electronics

In this sub-sector, there are 13 Companies employing 1200 persons. Total employment reached almost 2000 people in the early 80s and was strongly reduced because of market conditions (devaluation of the Dirham and decrease of buying power) and also because TV sets manufacturing needs much less manpower than it used to need ten years ago.

Ten companies assemble TV sets within 1986:

| | |
|----------|-----------------|
| Color TV | : 135 000 units |
| B&W TV | : 45 000 units |

The other companies produce car radios, Radios, Cassette Recorders and even VCR (small quantity).

There is a small difference in Custom tariffs between CKD collections and components bought separately.

TABLE 7 - CUSTOM TARIFFS FOR TV SETS

| | CKD | Separate components | Finished sets |
|--------------|-------------|------------------------|------------------|
| Customs | 7.5 | 15.0 | 45.0 |
| Fiscal Tax | 12.5 | 12.5 | 12.5 |
| TOTAL | 20.0 | 27.5 | 57.5 |

Source : ODI

The difference is of 7.5% between CKD collection and separate components and 37.5% between CKD and assembled TV sets which is an appreciable protection for the local industry. The VAT is 19% on most of consumer electronics.

TV Manufacturers used to buy only CKD collection from the Associated Foreign Companies (Thomson, Philips, Hitachi...) at a very high price but things have changed since 1985. The first reason is the tough competition between the ten firms on the market and the decrease of buying power of the local population. The second reason is practical procedures that allow the local firms to buy from everywhere and put them into collection inside the country and not outside as it is the case in many countries.

The result is that the local firms have strongly diversified their supplies and now buy from the cheapest sources (Korea, Taiwan, Japan). The result is that prices have frequently remained constant despite the devaluation.

This purchasing improvement was not followed by a technical one and it can be understood as a result of the large fragmentation of the market. The value added is about 30% of sales which is higher than in Tunisia but is small compared to developed countries.

The ratio ex-factory price/direct cost (materials + direct manpower) is around 1.7 against 2.5 to 3 in Europe. This ratio is very important : the higher it is, the better the company can finance indirect expenses such as R&D, Marketing and Management. When it is low, the Company has no scope to move technically and commercially.

Fragmentation of the market is also a thread as the production size of all the companies is small compared to international standards (200 to 300000/year).

PART THREE LOCAL MARKET, PRODUCTION, IMPORT AND EXPORT

The Apparent Market for Electronic Products was estimated at 167 M\$ and half of it is covered by local production. Our sources for the following figures are official figures with some modifications. The export figure for components is estimated because SFRM declares its Exports in "Services" and not in electronic components. The figure for Automation Imports includes an estimation of the Hidden Market, included in Capital Goods.

TABLE 8 - PRODUCTION, IMPORTS AND EXPORTS OF ELECTRONIC PRODUCTS IN MOROCCO IN 1986

| | Production | Import | Export | P+I-E | P/(P+I-E) |
|------------------------|------------|------------|-----------|------------|-------------|
| Components | 23 | 37 | 21 | 39 | 59.0 |
| Industrial Electronics | 11 | 63 | 3 | 71 | 15.5 |
| Communication | 8 | 33 | 1 | 40 | 20.0 |
| Data Processing | 1 | 18 | 0 | 19 | 5.3 |
| Automation | 2 | 12 | 2 | 12 | 16.6 |
| Consumer | 56 | 1 | 0 | 57 | 98.2 |
| TOTAL | 90 | 101 | 24 | 167 | 53.8 |

Source : ODI, SB

The coverage rate (Production/Market) is very good for Consumer Electronics) and very low for Industrial Electronics.

For components, the imports are mainly directed to consumer electronics and TV. Components share is over 65%. Local production of components is mainly exported and the result is that there are two separate flows, one coming in for assembly plants, and one going out from subcontracting firms.

The potential market size depends on many parameters. For Consumer Electronics, production increased after the import liberalization by more than 50%, which means that the potential market is more than what it is today and according to Local Authorities it could double if the electrification program is accelerated and if prices get lower. The price of 21" Color TV is around 700\$ including all taxes which is a very high price compared to international market prices and even to Tunisia where prices are much lower. (The same set costs 500\$ in Tunisia, 250 to 300\$ in the USA)

The market for Communication Products could be multiplied by 2 or 3 and Data Processing market is growing by more than 50% per year with no saturation. Industrial Electronics market could reach 180 M\$ in 1990 if the big investment in Tele-communication is carried out.

The market for components should follow the finished products trend and many imported parts could be easily produced locally.

In total, we estimate that the potential market is around 300 M\$ which is a better figure than it is today but still far away from European Market which is about 1000 times the local market (155 Billion \$). Morocco is an associated member of the EEC and that gives him access to a huge market.

PART FOUR THE INDUSTRY ENVIRONMENT

I. THE INSTITUTIONAL ENVIRONMENT

The Institutional framework in which operate Moroccan Companies has deeply changed these five last years and at the first place, the incentives policy, then the Institutions in charge of industry promotion.

There are three types of incentives in Morocco:

- protective incentives for the local industry such as tariff barriers and import restrictions
- Investment promotion incentives with financial and fiscal measures
- Export incentives

Local industry protection has been fought by the World Bank and import restrictions have been strongly reduced. Tariffs barriers are still heavy. They are from 30 to 50% but there is no differentiation in the real need for this protection. Consumer Electronics even if they do a small added value, benefit de facto from these tariffs and have been expanding, but Industrial Electronics such as Computers or Telecommunication Equipment are less lucky and they have a very small protection.

The Investment Promotion Incentives of the 1963 Investment Law (no custom tariffs on capitals goods, Tax cutting for different classes of geographical areas) acted in favour of capital intensives projects for the local market. Foreign investments were attracted when the output was mainly exported or when they were in minority compared to local investors.

The incentives for exports were classical: Tax holiday for export activities, no custom on inputs and capital goods, export credits and export Insurance.

The new law of March 1988 has increased foreign investment incentives. The new measures are:

1. Total freedom of investment when financing is done with foreign currency.
Investors have no more limitation in buying shares of new companies or in capital increase and opening associated credit accounts.
2. The transfer of benefits does not need any Central Bank Authorization
3. Simplification of foreign exchange for imports and travels.

Besides general incentives, there are some Public Organizations which take a major role in industrial development.

The first one is the ODI (Office Pour le Développement Industriel) which which has the following actions:

- . Information and assistance for local and foreign investments.
- . It has three offices in Belgium (For Benelux), France and Germany.
- . It carries out sectorial studies with project identification and pre-feasibility studies.
- . It helps new investors by conducting market studies and even by doing complete Business Plans.
- . It is an interface between sellers and buyers of subcontracting services or goods.

- . Organization of, or taking part in, international fares.

- . It acts as a project development organization and takes shares in new projects. Its shares in joint ventures were about 65 M\$ at the end of 1986. It has the majority in eight companies and the minority in twenty-five others. Its shares in Mechanical, Electrical and Electronic Industries are only 5 Millions \$ which is a low figure compared to Textile and leather (37 M\$) and Chemicals (15 M\$). In the Electronics Industry it has less than 100000 \$ of shares.

The ODI is financed by public funds and its privatization is in the air. This should mean that it will sell its services and be responsible for its participation whether they are working well or not.

The other institutions are the Ministry of Industry, the OCCE (Office Chérifien du Commerce Extérieur), exporters assistance and information, Professional organizations and Mixed (Franco-Maroccan...), Chambers of Commerce. These Chambers of Commerce have a good reputation in setting contacts between potential partners and many joint ventures were established after these contacts.

In short, none of these organizations or incentives are directed specifically to one sector or another and we think that the Electronic Sector cannot strongly expand without specific measures.

The volume of foreign investments is still low compared to the local ones and the first reason invoked by foreign investors for this low level is the weight of bureaucracy and the complexity of procedures specially for somebody who does not know at all the habits of the country.

II. EDUCATION, R&D AND INNOVATION

The Education in Electronics and Data Processing has much increased by numbers and quality these last five years. The major part of electronic engineers go abroad for their studies mainly France, USA, Canada, Germany and Benelux. Their number is hard to estimate but the people met in Morocco gave us the following figures: about 100 engineers in software and hardware complete their studies every year in European or American Universities more than half of them do not come back to their home country. Some of them (10%) come back later. In Morocco, mainly in Casablanca where there is a very good level of education, about 50 software and hardware engineers come out of universities. It seems that there is no shortage of engineers and the weak part of manpower is more in middle level technicians.

This population of engineers work either in large public companies, administrations and banks or start their software or distribution company but few of them work in their original field in industrial companies. The reason invoked by these companies are various and one of them is very serious: the income tax system which is very progressive and reaches 50 to 60% very quickly. Company executives talk also about the direct usability of engineers and say they have to train them on the job and sometimes leave when they get better wages from the competition.

Research activities have a good place in the education of engineers and beside fundamental research, many students have the opportunity to do their work in private companies specially in data processing. This new link between the University and the Industry seems to be appreciated by all sides. It gives the student a good contact with the reality of the industry and probably a natural job in his own field.

The Lakhdar Guazali Institute of Arabization has a very good reputation in the Arab World but it has some inertia to technological evolution. It did substantial work on arabic character representation and lexicography and worked with an Italian Research Organization in Frascati to introduce Arabic data processing equipment. In this area, the Institute lacked contracts with serious industrial companies and preferred to work with small ones.

It seems that the Government has invested a lot of money and energy in education and R&D and that will give the country a serious chance of development.

III. FINANCIAL RESOURCES

The financial system in Morocco is very different from the other African countries:

- There are few large banks: the assets of the two first banks are around two billions dollars (1986) but there are many middle size banks (ten of them have more than 500 millions\$ of assets)
- The foreign shares in Moroccan banks are very small
- Many banks are completely private

This means that there is a good flexibility in the financial system. In Industrial Investment and Credits, BMCE, BCP, BNDE, BCM, and BMCI are the most active. They have a good reputation but they act in a classical way, though the competition between them led to innovations in financing methods. There is no venture capital fund but some banks are coming to the idea that new and risky sectors such as Electronics must be treated in a specific way. It does not seem that there is a shortage in money in Morocco and financial resources could follow a major development of the electronic sector.

PART FIVE PROSPECTS FOR GROWTH

The Electronic Sector was developed in two main directions: Consumer Goods for the local market and subcontracting for foreign firms. The sector started this way and is roughly in the same state today. The outside picture has remained the same but working conditions have changed. The start of introduction of open market rules and export incentives gives new horizons to local companies. The cards are not completely drawn as it seemed a few years ago when there were fifteen companies making consumer goods for such a small market, no exports and no international competitiveness.

The World Electronic Market is a huge market: 600 Billion dollars but also an intense competition. The countries that used to produce low-grade products such as Korea, Taiwan and Hong-Kong have now companies fighting on the international market with quality products they sell even to Japan which has a very difficult market. The NIC that have a significant share in the world production are presented in the following table.

TABLE 9 - SHARE OF THE NIC IN THE WORLD MARKET OF ELECTRONIC PRODUCTS

| | Population Millions | Production Millions \$ | Production \$/Capita | % World Market | World Rank |
|-------------|------------------------|---------------------------|-------------------------|-------------------|---------------|
| South Korea | 41.0 | 10600 | 258 | 1.8 | 7 |
| Taiwan | 19.6 | 8900 | 454 | 1.5 | 8 |
| Singapore | 2.6 | 6100 | 1807 | 1.0 | 9 |
| Brazil | 135.6 | 5600 | 41 | 0.9 | 11 |
| Hong Kong | 5.4 | 4800 | 814 | 0.8 | 12 |
| Morocco | 22.5 | 90 | 4 | 0.011 | |

Sources : World Bank and various market studies

From this table, we can notice that Brazil produces 10 times more electronic products per capita than Morocco, South Korea 60 times, Taiwan 100 times and Singapore 450 times.

We think that production could be at least multiplied by ten in which case this sector could have a significant place in the industry. It was less developed, in the past twenty years, than other "natural" sectors in which the country had comparative advantages and this means that the Electronic Sector cannot grow naturally.

In all the NIC that have today a significant production, the Electronic Sector had a specific policy and specific advantages and it seems obvious that it must be the case in Morocco if there is a political decision about it. It seems obvious that import substitution is not a good way to go and except Brazil, all the NIC have put either export or foreign firms attraction as a priority. It is also obvious that a major development cannot be achieved only by internal means and an equilibrate association must be found today.

We will try to see what are the areas where the Moroccan industries could be competitive and what are the conditions of success.

I. SUB SECTORS ANALYSIS

1. Consumer Electronics

The World Market for Consumer Electronics was about 60 billions\$ in 1986 with the following distribution of production by region.

**TABLE 10 - THE WORLD MARKET FOR CONSUMER ELECTRONICS (M \$) AND
PRODUCTION SHARES IN 1986 (%)**

| | Market (M\$) | USA (%) | Japan (%) | Europe (%) | ROW (%) |
|----------|-----------------|------------|--------------|---------------|------------|
| Color TV | 20000 | 22 | 25 | 28 | 25 |
| B&W TV | 1500 | 5 | 5 | 2 | 88 |
| Video | 17000 | 2 | 78 | 7 | 13 |
| Audio | 14500 | 6 | 39 | 10 | 45 |
| TOTAL | 60000 | 11 | 45 | 15 | 29 |

Sources : various market studies

Each segment or sub-segment has its own market conditions and technology difficulties:

- Video equipment which is a fast growing market is heavily dominated by Japanese Companies whether they produce completely in Japan or do the final assembly near the Markets (only SKD). South Korea with its four giants has spent considerable efforts to master the technology (specially for heads) and has gained almost 10% of World Market share. This segment must be excluded from our analysis.
- Color TV which is still a very big market with over 65 millions sets sold over the World. The leading companies in Industrialized Countries were deeply restructured and are trying to move upward to the high end Market. They started with FST, Stereos and big screens and are investing in digital and high definition TV. They left the low end to South East Asia countries and the Market is being invaded by low price Color sets from Korea, Taiwan and now Malaysia and Indonesia.

It could be a good opportunity for Morocco, but the time window is short (less than three years). Morocco invested in Consumer Goods "Software" by establishing a very dynamic and successful radio station and a private TV network will be started next year. This network will sell its programs not only in the area but also in Europe where important Arabic minorities could have access to an Arabic channel through cable networks.

The Moroccan TV manufacturers have gained much in purchasing know how and must now invest in R&D, marketing and modern production equipment. All the companies that succeeded in NIC started by the low end and now you can find FST and even digital TV made by Samsung. The companies that want to go on the International Market must be able to produce a digital TV at a good price in 1993 and high definition TV in 1996. A good way to enter the market is to find agreement with large department stores in Europe and make TV sets for a brand owned by these stores before gaining an international reputation.

- B&W TVs is a decreasing market and is totally dominated by the Far East countries that have unbeatable prices both TV sets or monochrome monitors for PCs. This segment is not impossible but the margin is very low and there must be efforts to reduce the costs in all directions (PCB, Tube, Plastic box...)

- Audio market looks like TV markets with its high, medium and low end segments and it seems hard today to enter this crowded market dominated by the Japanese for Hi-Fi and S.E Asia for radios receivers and radio cassettes.

- Satellite antennas and related electronic equipment are still expensive products in Europe and in Africa but the direct broadcasting satellite planned for the next few years will change the situation. Prices and dish size will drop and market size will be much bigger. Japan is concentrating on flat antennas and miniature converters that will probably be sold under 500\$ and S.E Asian countries are entering the market with more classical products. The association of satellites and cable TV such as those used in hotels and large buildings are certainly an opportunity to study carefully in conjunction with the private TV network under completion.

What type of association should be the best fitted for Consumer Electronics ? The contract of technical assistance signed between a Moroccan Group X With an international company Y which took a significant share in the projected TV Company is very typical:

- . Y must give all the components's specifications
- . X has to buy all the components from Y. For those which cannot be supplied, Y will indicate other sources.
- . All the components bought from Y will be used only for TV manufacturers and cannot be sold outside the company except for maintenance needs.
- . X cannot sign any other agreement with other companies for all TVs.
- . Y has the right to control the quality and the good use of its components and know how.
- . The contract is signed for 10 years.

It is obvious that this type of contract is very constraining and does not give any freedom to sell everywhere. The cost of the assistance is also very high and fortunately some new starters do not use technical assistance.

The second solution is to attract world leaders in the field to locate one of their world plants in Morocco. The fact is that none of these leaders already came to the country and recent moves were in Portugal (Samsung, Grundig) or Spain but not in Morocco. These companies had in mind the globality of the Common Market and thought more in terms of access to a big market than real economic conditions. The availability of quality subcontracting services were not in favour of Morocco: Portugal is for instance one of the cheapest sources of Plastic Molds and there are very few tooling specialists in Morocco.

The best solution is probably in between: an association with a leader but after having built a solid background in the field and with no obligation like those mentioned earlier.

2. Industrial Electronics

2.1 Communications

It seems obvious that Moroccans will put a priority on the modernization and extension of public networks. This improvement was planned many years ago and rescheduled many times with at each time a reduction in the planned investments due to the financial problems faced by the country. Now that the country situation has much improved (the balance of payments should be equilibrated this year), the plans are again under study.

- For public exchanges, the Authorities want to reach quickly a high level of digitalization and it is likely that the market will be divided between a Canadian (NT) and a French (Alcatel) with a planned local manufacturing. We don't know yet if there will be two separate factories or one making both systems.

The projected number of lines to be installed each year will be from 100000 to 200000 which is the lower limit for a serious local assembly plant. Algeria chooses Ericsson AXE and will manufacture it in replacement of the present crossbar system of GTE and it is unlikely that Tunisia will manufacture public exchanges and as the chosen systems are Alcatel E10B and Ericsson AXE, there may be an additional market in Tunisia.

The problem with digital public exchanges is that there are extraordinarily complex to design and R&D investments for one system exceeds by far 1 billion\$ and we do not see very well the long term strategy of such a project. If we look back to projects such as NT in Turkey with Teletas, it was a very good project 15 years ago because crossbar manufacturing needs a lot of manpower and with a heavy investment in R&D and training, the Turkish Company designed some interesting small and rural exchanges which could be sold in developing countries.

We don't think that the same story could happen again today. The only positive thing would be a know how acquisition of installation and maintenance that could be exported as a service.

- Private exchanges (PABX) and key systems have a large potential market in the country and in the area. These products involve many services including installation, programming, maintenance and users training, and we think that there should be 2 or 3 dominant lines of products in order to have good production sizes. The Moroccan Market will be mainly in small configurations (under 50 or 100 lines) because of the large number of small-scale companies and the projects should concentrate on these sizes.
- Terminals are also an interesting area and they could go from simple telephone sets to feature telephone sets and custom made (to work with PABX) and there is a good market size. There are discussions with French, German and North American Companies for local manufacturing.
- Transmission and rural telephony could also be a good field to explore, given the size of the country, the topology and the large number of small towns and villages.

- Beside purely electronic equipment there is a huge market for different types of hardware associated with public and private exchanges: cabling systems, connectors... These products could be easily made by flexible small companies with good capabilities in plastic and metal work.

2.2 Data processing

Our estimate of the number of PC installed in the country is 8000 to 10000 professional configurations with about 50 different distributors. This gives a ratio of 0.4 computer per 1000 inhabitants. This figure has to be compared to 50 in the USA and from 10 to 25 in Western Europe. The margin for growth is very large and computers, beside productivity gains, is more and more a cultural tool and should be introduced in all steps of education.

This also applies for administration and public services and computerization should be considered as a part of infrastructure at the same level than telecommunications. A country like Singapore, with its well-known efficiency and openness, specially in its administration, has launched two years ago a very large program of computerization at all levels. It associated Universities, Research Centers, private software houses and final users to come out with the best solutions.

This type of programs could give a new breath to the local software and hardware companies. But these programs have to be oriented in such a way they can fight the present weaknesses which are a big fragmentation and a complete lack of specialization.

Software is a difficult area today: anybody can buy a computer, a few development tools and starts designing custom applications for a small business and then try to sell it somewhere else. It is difficult for him to reach a large size unless there is a specialization and human and financial means.

Things change a lot when a software company wants to export. None of the small companies would be able to afford travel expenses to sell its software a few thousand kilometers away. Three type of software are exported today:

- Standard software such as Word Processors, Data Base Spreadsheets or Development tools. People talk very much about Arabization software and specialized Word Processors and other products. This market exists but it is much less important than the one of latin language softwares and when Microsoft and Lotus sell millions of copies of a standard software, they earn enough money to have hundreds of software developpers working on the next versions. We think that it is quite impossible for a new company to keep with the pace of World Leaders in terms of software capabilities, packaging, documentation, support services. We also think that it is possible to discuss technical agreements with these leaders to develop an Arabic version of their software at a small cost.

- Specialized software packages such as CAD, Technical Softwares, Networking packaging. A Moroccan software company took recently the control of a French firm specialized in Architecture and Construction software and started joined development for the new versions, Marketing being shared between the two companies. This type of software is expensive and can travel much better than the custom made software. We think that this area is very attractive and there is probably a big market in subcontracting, for instance in database filling or maintenance, associated with technical software.

- The third type is large size software such as Banking, Airline, Transaction software which are very complex and custom or semi-custom made. The companies that can provide this type of service are large and specialized companies with often more than one thousand software people. In this field, it is only by an association with a leader that this activity could start.

On the hardware side, the only way to have a strong company is by innovation and by standing with the technology. For instance a simple French company came to the market with a fast AT mother board that was less expensive than equivalent Taiwanese boards and seems to be very successful. They started from the idea that the sensitive chips (microprocessor, BIOS proms and controllers) were available only from a limited number of suppliers (Intel, Chips and Technology...) and the other are mass market components available from everywhere. So this company could design this board with one additional semi-custom chip. There is also a large number of modems and other countries products and we think that this market could be interesting for young companies with good R&D capabilities. There must be an inexpensive supply of PC boards including multilayer ones which are today very common in this field.

2.3 Automation

Automation products and systems become more and more a vital part of industrial and service sectors. They involve a complex chain of services from engineering to maintenance supplied by separate companies.

In the process control field (for steel plants, refineries, cementeries...) there is an important interaction between the end-users and services suppliers in the definition, the design and the installation of automation systems. In industrialized countries, large size users have often an automation department that intervene in the life cycle of automation systems and become often a service company for other companies (not necessarily in the same production type) or start a subsidiary for that purpose. In Morocco, large process industry companies should act that way and invest in automation know how. Many automation problems are common to completely different industries and solution could be easily transposed (after changing the external technical words so that the user fully understands).

It is the first step of a larger control on automation problems and a better development of local subcontracting in other fields than just wiring or control panel building.

In the sequential control area (Discrete Piece Manufacturing) replacement of hard wired systems by programmable solutions should be accelerated, the same way than data processing is introduced in business applications. The association of programmable controllers and Personal Computer is very popular today (the computer is used for programming, documentation, supervision and the controller for floor shop control). It is a flexible solution that could be applied to many small shops or small batch processes such as Food or Parachemical industries. There is a place for many services companies in this field. There is a lot of other applications such as security control, energy management... that offer an important potential market and could be addressed with solutions such as the association of PLCs and PCs.

Another area that has to be studied carefully in power supplies in all type of configurations: standard or custom made, internal or external, small or large power, UPS and Stand-By systems. This field has an average level of technology; it is a mixture of metal, plastic, power and logic electronics and is less adressed by developed countries than main digital electronic products. The proximity market of Europe is surely a very good market for many small size companies and the local market is also interesting.

3. Components

3.1 Passive and mechanical

PCB is a very important product in the Electronic industry. For a long time, its price did not follow at all the general trend of price decrease and the share of the PCB in the cost of a product was increasing. With the tough competition of today and the always increasing complexity of digital electronic products, multilayers PCBs become very common and prices are down.

Morocco has a very good opportunity in PCB in subcontracting for European manufacturers which were not able to follow the price trend. This market is very large and there could be several units of medium size (50 to 100 people) just as what can be found in Northern Italy or in Greece. These units must be flexible and prices competitive. We think that there are a lot of good used or second-hand equipment that could very well be bought for a very good price, as investments are very high in this field and amortization counts generally for more than 10% of the cost.

This technology is well known but it is still complex and precise and the best way to get into it is to find a few good technicians in Europe and to train local ones and a few salesmen able to find markets. The companies that have already started to produce PCBs should be encouraged to expand their production lines to more complex products.

Subcontracting in wire and cables has been well developed in Morocco and many small companies are rapidly expanding. There are still good opportunities in the field as automation has not been able to solve all the production problems.

Transformers are a good niche but these products are heavy and do not travel very well. New trends for miniaturization and products for surface mounting devices make this area a little more technology intensive which could be a chance for a new starter today. Countries such as Mexico have widely developed the production of transformers for export.

Capacitors, specially power or high quality ones, are also changing with technology and this field should be studied further on as a potential activity. Quartz devices (crystal, oscillators, filters) should also be studied specially for custom made or high quality products.

3.2 Semiconductors

The front end part of semiconductors industry has become highly capital intensive and a very high volume area with very few exceptions. Many NIC such as Korea, Taiwan and Hong Kong have established S.C. companies with a concentration on consumer type of ICs such as clocks, games or calculators chips, but this has always been done in conjunction with a nearby industry using these chips. The only major effort for export was made by Korean firms in the RAM area after huge investments.

It seems very hard to find a niche for an independant company in this field. Packaging and Back End processes are another story. A large part of this activity is made now by independant companies in the Philippines, Singapore or Malaysia and many IC manufacturers have left this part to subcontractors for economic reasons. It seems that the niche of power and specialized packaging in which SFRM is in the hand of STC and Thomson and offering this service to other companies is relying on their strategy.

The design of custom or semi-custom ICs is an important field as a large part of new electronic products are designed using this type of chips. It seems important today to have a small Design Center to get into this vital technology and may be offer a subcontracting service later.

IC testing becomes today essential in quality control which must be present everywhere in the factory and a solution must be found either by starting a test house or by having agreements with foreign test houses or public centers.

II. CONDITIONS OF SUCCESS

Morocco went through a hard period these last ten years but austerity seems to have given new reflexes to industrial managers specially when dealing with International Markets. All the potential segments we talked about earlier could give the country a much better place in the World Electronic Industry but there are a few conditions of success that we think compulsory.

1. The first one is the type of "human content" of this industry that has to be the right mix between low costs basic manpower and R&D type of engineering manpower with an appropriate use of Automated equipment. The local industry has made a big progress in basic manufacturing techniques (such as plastic, metalworking, winding...) and this should be associated with "Value Analysis" techniques that are able to see how the world competition has designed its products, why did they take this solution for this problem, and how it could have solved with a less expensive solution. This analysis could be a complement to Technology Complexity Analysis. The external look and the mechanical design of electronics are at the same time fundamental for reliability and marketing and not very complex to learn.: an attractive and strong product is much more appreciated than an average product with th same qualities. The internal content or the electronic design should also be studied carefully and it is the first step before designing its own products.
2. The second condition is break the isolation between international subcontracting and industries working for the local market. All the countries that have succeeded in this field have based their production methods on specialized and well-priced subcontracting to reach a competitive price at the end of the manufacturing process.

3. The third condition is to study carefully why foreign investment is not attracted and put the right incentives to develop further this sector. The new incentives should be directed to encourage R&D activities and technical training by giving subsidies for these activities. These incentives should be given as well to foreign companies that need more and more highly educated people as to local companies that have not enough margin to finance long-term effort in technology.

4. The fourth condition is to introduce strategic methods in governmental decisions such as helping or not this type of industry and let that other one die because they are not competitive. This is also true for the use of public markets as a way of helping the industry to grow up. The high level of fragmentation in segments that are typically specialized or volume segments is a serious thread to the longevity of this industry. We have heard speeches talking about employment protection by putting protective taxes but we never heard somebody talking about strategic coherence of companies and development means.

It is obvious that in a world of specialization, it would be a complete mess of energy and money to try to go all the directions at the same time.

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