ECONOMIC AND SOCIAL COMMISSION
FOR WESTERN ASIA (ESCWA)

ARAB INDUSTRIAL DEVELOPMENT
ORGANIZATION (AIDO)

DEVELOPMENT IN THE CAPITAL GOODS AND ENGINEERING INDUSTRIES

A FRAMEWORK FOR A MASTER PLAN FOR THE DEVELOPMENT OF TECHNOLOGICAL CAPABILITIES IN THE CAPITAL GOODS AND ENGINEERING INDUSTRIES IN THE ARAB WORLD

ESCWA
INDUSTRIAL DEVELOPMENT SERIES
NO.1

Prepared jointly by:
ESCWA/UNIDO INDUSTRY DIVISION

AIDO GLOBAL STUDIES
DEPARTMENT

July 1987

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LIST OF ABBREVIATIONS

AIDO	Arab Industrial Development Organization
CAD/CAM	Computer aided design/Computer aided manufacturing
CKD	Complete knock-down
CC	Cubic centimetre
ECE	Economic Commission for Europe
EIDDC	Engineering and Industrial Development Design Centre
ENPPI	Egypt National Petroleum and Petrochemical Institute
ELMACO	El Nasr Co. for Transformers and Electrical Products
FMS	Flexible Manufacturing Systems
GAFI	General Agency for Industrialization (Egypt)
GCC	Gulf Co-operation Council
GDP	Gross Domestic Product
GNP	Gross National Product
GOFI	General Organization for Industrialization (Egypt)
GVW	Gross vehicle weight
hp	Horse Power
IMR	Invest Import Company (of Yugoslavia)
ITRDC	Industrial and Technological Research and Development Centre (Syria)
KD	Kuwaiti Dinar
KNPC	Kuwait National Petroleum Company
KREMENCO	Kuwait Industrial Refinery Maintenance and Engineering Co.
KV	Kilo-volts
KVA	Kilo-volt-ampere
LV	Low Voltage
M	Metre
METALCO	Egyptian Company for Metallic Construction (Egypt)
M.V.	Medium Voltage
MV	Mega-volt
MVA	Mega-volt-ampere
NASCO	Nasr Automotive Company (Egypt)
NTP	National Technology Policy
R & D	Research and Development
RSS	Royal Scientific Society (Jordan)
SKD	Simply knocked down
SIMAF	Egyptian Company for Railway Equipment (Egypt)
STEELCO	Engineering Projects for Steel Works (Egypt)
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization

PART ONE

INTRODUCTION

1.1 Objective

The objectives of this study are:

- To identify and assess the present technological capabilities in the capital goods and engineering industries in the Arab countries;

- To review expected future developments in the technologies of these industries in the industrially advanced countries;

- To provide a proper framework for a master plan for the development of technological capabilities in the Arab countries.

The study is one of three studies undertaken jointly in 1986-1987 by the Economic and Social Commission for Western Asia (ESCWA) and the Arab Industrial Development Organization (AIDO) on the development of technological capabilities. The studies cover the following industries:

- Capital goods and engineering industries;
- Oil refining, petrochemicals, and fertilizers,
- Iron and Steel.

This study incorporated and updated a study that was completed by ESCWA in 1985 which covered the ESCWA region. The scope of the present study was enlarged to include non-ESCWA Arab countries, in line with the terms of reference and requirements of AIDO.

1.2 Background and justification

The structure of manufacturing output in the region reveals its predominant orientation towards the production of consumer and intermediate goods. This industrial structure consists, for most countries, of a large variety of scattered enterprises including certain chemical formulations or engineering industries, usually assembly operations with limited linkages between them and little complementarity in their production. In more recent years, basic industries have been developed including primarily petrochemical and energy-based industries. However, complex and integrated industrial activities in the field of capital goods and engineering industries have only recently been given adequate attention by some States. While the lack of resources and the limitation of the market at the national level may have prevented the establishment of such industries, the absence of a regional outlook in dealing with the problem of industrialization has certainly been an important added factor.

The demand for capital goods and engineering products has been growing at an exceptionally high rate due to the implementation of ambitious development programmes. The limited international production base and the fragmented nature of the industrial sector, combined with lack of complementarity in production, has been reflected in the phenomenal increase in imports.

Thus, the import of engineering products into Arab League countries increased from $1,351 million and $877 million respectively in 1963 to $39,854 million and $29,248 million respectively in 1979. In percentage terms, the Arab League countries imported between 3 and 4.5 per cent of world exports in engineering products during the period 1963-1974; this increased to 7 per cent in 1975 and to 9 per cent in 1980.

It is within this dynamic and expanding market that ESCWA and AIDO programmes on the development of capital goods and engineering industries have been conceived. In considering the possibility of formulating such a programme, at the national level, very few countries in the region will, in the foreseeable future, possess the minimum adequate market size and resources, or have an economic structure containing the necessary elements for the realization of such a programme and for creating an efficient and resourceful industrial sector within the economy.

AIDO and ESCWA programmes in this field aim at promoting the development of an integrated long-term regional programme for the development of capital goods and heavy engineering industries, with strong linkages to related national industrial facilities. These programmes are envisaged to be of a sufficient "mass" for providing the nucleus needed to develop industrial capacities and technological and managerial capabilities in the field of engineering industries. This would bring the countries concerned to the take-off stage and provide a dynamic and flexible instrument for effecting future changes in this important field.

In view of the two organizations substantial involvement in promoting the manufacture of capital goods, it seemed both logical and essential to study the existing technological capabilities in order to formulate a plan to improve them.

1.3 Scope of technological capabilities

The development of the capital goods industry calls for the development of a vast array of capabilities, not only relating to selection and acquisition of technology and know-how, but also to planning, executing and operating complex industrial plants.

The manpower required to absorb the new technology, to operate and service the plants and to expand activities must possess a wide range of capabilities including skills in the following areas:

- Selection of technology
- Negotiation of technology contracts
- Project identification
- Pre-feasibility studies
- Feasibility studies
- Engineering and plant design
- Construction of plants (factories)
- Supervision of plant construction

- Process design
- Product design
- Production management
- Maintenance and repair
- Manufacture of spare parts
- Research and development
- Plant technical services
- Customer technical services (after-sale services)
- Marketing.

In part three of this report, these capabilities are assessed separately and indepth in various countries and for different projects. However, it is to be noted that these capabilities cannot be easily generalized since their scope may differ from one project to another. If a capability to undertake pre-feasibility or feasibility studies exists, this may mean that for certain projects 100 per cent of the activities needed can be performed internally, while for other projects the involvement of affiliate offices or outside consultants in addition to internal capabilities becomes necessary. It also depends on the type of project undertaken, whether it involves a new plant or an extension of an existing one, whether it is a study for a new installation or for additional equipment, whether it is for the introduction of a new process or the improvement of an existing one, whether it is for the installation of a new production line or modification of an existing line, and so on.

1.4 Methodology

In order to assess the existing technological capabilities in the Arab world, it was necessary to collect all information pertinent to the capital goods and engineering industry. The data collection activity was undertaken in two phases: desk work and field work. The first phase, the desk work, covered the collection and analysis of all relevant published information at the national, regional and international levels. It included surveying the literature on the subject, including technical and economic periodicals and specialized reports. A comprehensive list of issues and topics related to the development of technological capabilities in the capital goods and engineering industry was prepared.

The field work started with the preparation of different questionnaires for each of the four groups of organizations engaged in the technological development process in the capital goods and engineering industries, namely:

- Manufacturing establishments
- Engineering design, consulting companies and contractors
- Laboratories, industrial and specialized research centres
- Universities.

The questionnaire for the manufacturing establishments solicited specific and, whenever possible, quantified information regarding the size and composition of the work force (by nationality, education level, function, etc.) as well as the capabilities of the establishment itself and other

national and foreign organizations and companies involved in its activities (selection of technology, negotiations with foreign sources of technology, pre-feasibility study up to marketing and after-sale services). The questionnaire sought to determine the major achievements of the establishments as well as their plans for the future. In addition it sought to identify and determine the linkages between those establishments and other organizations at the national, regional and international levels.

The questions submitted to consultants and contractors dealt with the relation between the branch office and mother company, sectoral activities they were engaged in, number and composition of employees and specific capabilities possessed.

The universities and research centres were asked to provide information on the number and respective specializations of their graduates and staff, the major research programmes completed, and co-operation with industry and possible work done for the benefit of manufacturing establishments on a commercial basis.

For each country, a list of relevant organizations was compiled, and local consultants in a selected number of countries were recruited as focal points. Their task was to conduct indepth interviews with senior staff of the organizations selected, to prepare background papers providing information on the existing capabilities and policies for developing them and to submit a case-study dealing with the transfer and development of the technology process in at least one national organization.

Pilot testing of the initial questionnaires was undertaken in the Gulf region and a number of modifications were made subsequently, taking into consideration the views of some leading organizations and experts.

A limited number of field missions were undertaken. The objectives included gathering unpublished data, identifying, recruiting and briefing the local experts, and filling information gaps where possible. For practical and financial reasons, the field missions were restricted to Saudi Arabia, Kuwait, Bahrain, Jordan, Syria, Egypt, Algeria, Tunisia and Morroco since these countries possess the bulk of the capital goods and engineering industries. Local consultants were engaged in Egypt, Jordan, Syria, Algeria, Tunisia and Morroco.

The questionnaires which were filled out and returned contained useful and relevant information in many cases. However, the response of different countries and the quality of the replies varied greatly. Many organizations did not respond to the questionnaires at all. Furthermore many questionnaires were only partly completed and most of the questions relevant to the study remained unanswered. In several cases the meaning of the question was not properly understood and the answer given was therefore not relevant. In addition, in some countries, the lack of response by an entire sector of the industry made generalization of the results of the questionnaires difficult; for example, in Saudi Arabia, Iraq and the Libyan Arab Jamahiriya no replies were received from the capital goods sector, and in the United Arab Emirates, Morroco, Algeria, Tunisia and Qatar the universities and research centres did not reply.

The field work activity is described in more detail in annex II, which shows details of the missions undertaken, names of organizations requested to fill the questionnaires and names of those that responded as well as names of local consultants.

The material collected and prepared by the local consultants (questionnaires, background papers, and case-studies) was analysed together with the data gathered through desk work. Country profiles were subsequently prepared for several countries, outlining the historical development of the capital goods and engineering industries, the technological capabilities developed so far, and the degree of independence from foreign technology suppliers.

In conclusion the study presented a number of recommendations and proposals for enhancing the development of technological capabilities in the Arab world.

1.5 Organization of the report

The report consists of five parts and two annexes as follows:

Part One : Introduction
Part Two : Status of the industry
Part Three : Current technological capabilities
Part Four : Future technologies
Part Five : Conclusions and recommendations
Annex I : Case-studies
Annex II : Field-work.

Part two surveys industrial development in the Arab countries and focuses on the major manufacturing establishments with respect to the technological contracts they concluded with foreign companies, the products they manufacture, their technological facilities and the main constraints or incentives that impeded or stimulated their growth. The approach used is to start at the project level, then to move up to the national level, and from there to see if a picture emerges. Of course this approach and the extent of the coverage was influenced by two factors: the limited number of countries that have a real capital goods industry and the availability of information.

Part three assesses the technological capabilities at the project, sectoral (specialized training centres, etc.) and national (universities, consultants, contractors, etc.) levels. In addition it assesses the capabilities of regional organizations engaged in technological development. In addition to examining the capabilities in each of these organizational elements and the linkages and interactions between them, the study assesses and examines the manufacturing establishments. The constraints and stimulants which influenced the approach in part two of the study are also valid in this part.

Part four deals with future technologies and their implications regarding technological capabilities.

Part five highlights the main findings of the study and presents proposals for strengthening and developing technological capabilities at the various levels.

Annex I consists of eight case-studies: seven from Egypt and one from Syria.

Annex II is a report on the field-work activities undertaken.

PART TWO

STATUS OF THE INDUSTRY

The state of development of the capital goods and engineering industries in the Arab countries varies significantly from one country to another. This is attributed to many factors: size of the market, availability of human, material and financial resources, availability of technological infrastructure and, last but not least, national priorities.

In the two Yemens and the United Arab Emirates the capital goods industry practically does not exist. In Oman, it is reported that transformers are being manufactured in the country, and that current production is 1,500 units per annum. Information on the types and specifications of these units is not available. Similarly it is reported that cables have been manufactured locally since 1983 and that the current production is 10,000 kilometres.

In Bahrain, the main industry is the aluminium industry, which relies on the importation of its material needs from abroad. Its production capacity is around 170,000 tons per annum, and the industry employs about 7 per cent of the Bahraini population. Other projects include the production of aluminium powder (3,000 tons per annum) and aluminium pipes, rods and sheets (6,000 tons per annum).

In addition, the country has construction and engineering industries such as concrete blocks, construction material and steel fabrication. It also has mechanical industries which include steel structures industry, ship repair and assembly of air-conditioners. The latter is assembled by the Oral Products Company which produces about 6,000 units per annum with the assistance of the Fredric Company of the United States. The company was established in 1970 and employs about 121 workers.

Qatar is relatively an industrialized country, considering its small population. The country has managed to establish heavy industries such as steel, fertilizer, and ethylene plants as well as cement and flour mills, etc. However, capital goods manufacturing has not been significant, and the country has not been successful in convincing the private sector to invest in light industries. One reason is the lack of interest of nationals to work in these industries, which will lead to great reliance on foreign labour. Another reason is the limited domestic market. The existing production is confined to aluminium profiles and steel rods and sheets used for building construction.

In the Libyan Arab Jamahiriya the capital goods sector is very small; its contribution to industrial production in total is less than 3 per cent. The Libyan Tractor Company has the capacity to produce 3,000 agricultural tractors per annum.

The status of the capital goods and engineering industry in the remaining countries is detailed in the following sections, for each country separately. It shows that the industry is relatively most advanced in Egypt, Algeria and Iraq.

2.1 Algeria

2.1.1 Development of the industry

(a) First stage

After independence, the Algerian industry faced a difficult situation. Some factories were completely neglected by their owners and were nearly closed, as for example, the wagon factory in Anabah and the steel structures factory in Wahran.

The factories which continued to function faced a decrease in the demand for their products and a lack of skilled manpower, especially in engineering design. It is important to note that all of the skilled manpower at that time were foreign as Algerians lacked the training opportunities which could have developed their capabilities.

The metal industry at that time consisted of a limited number of plants (workshops) centred in the cities of Algiers, Wahran and Anabah which specialized in metal structures (light and medium), and simple copper works as well as some complicated products such as dam and railway equipment.

The first Algerian experience in the technological field was the reopening of existing plants which had suddenly lost most of their manpower. This experience proved that it was impossible to manage the capital goods technology without skilled manpower, especially in the fields of engineering design, production, management and marketing.

Some factories were reopened, and the more skilled workers, specifically machine operators, were appointed at higher levels. The operational factories became less in number because some plants had their parent company in France; therefore, their activities decreased and there was a tendency to liquidate projects.

The main factor which affected the capital goods industry at that time was the establishment of the iron and steel industry. The opening of the Al-Hadjar Steel Factory resulted in the reopening of all existing workshops and proved that existing capacities with regard to engineering designers and technical and production facilities for the manufacturing of heavy steel structures and copper works were inadequate.

The factories in Anabah were able to reopen only after the establishment of the Al-Hadjar Steel Factory, which provided these workshops with some work. The products being produced then for the iron and steel industry were pulleys made especially for conveyers and separating rollers used in the iron and steel, mining and cement factories.

The wagon factory was also reactivated, after new orders had been received. The past experience of workers and the availability of designs made that possible; some difficulties were encountered in the design sections, which depended on foreign technical capabilities, as very few national engineers were available.

(b) Second stage (1968-1971)

This stage started with the establishment of the National Company for Steel Industries (NCSI). The organization controlled the few nationalized companies and negotiations to buy the other companies continued. The following table shows the manufacturing plants during that period.

Factory/plant	Products
Anabah	Light and medium steel structures
Hussain Dey	Light and medium steel structures
Wahran	Light and medium steel structures
Wadi Samar	Light and medium steel structures
Al-Ruwaib	Electric tower structures
Alaliy	Wagons, reduction gears, pulleys
Alshati Al Ahmar	Hydromechanic equipment factory equipment and light bridges

The methods of production and management in these units differed in the sense that some were organized in a workshop manner, and the design offices were found in the headquarters of the parent company such as in the Anabah and Wahran plants, while others had organized their design offices internally. All these plants produced similar products; therefore, they were always competing.

The National Company for Steel Industries (NCSI) started by organizing the methods of production and preparing the basis for promotion and development. The production in the period 1969-1971 increased in comparison with the demand in the previous period (see figures 1 and 2), mainly because of the government decisions to double actual production capacities. The production was based on the designs made by foreign engineering firms because of lack of local facilities within NCSI and the dispersed capabilities within the established plants; this lack was rectified by the establishment of an engineering and design unit in NCSI, which was authorized to establish industrial complexes. In addition, the company established the Civil Engineering Organization, and an organization for manufactured structures and equipment; these innovations were the result of the NCSI goal to become the main factory supplier instead of sub-contractor and to reach a high percentage of self-sufficiency. The company further decided to make changes in the main sections with the objective of eliminating weaknesses.

The company implemented the following activities to make the production process effective. It combined the different facilities in the factories which were responsible for procurement and raw material storage in order to decrease prices and storage facilities; in addition, it combined capabilities in design and marketing of steel and copper structures by establishing a technical trade division, with the aim of unifying designs and marketing policies. This resulted in the following:

(a) An increase in productivity, though the units were using the same production methods;

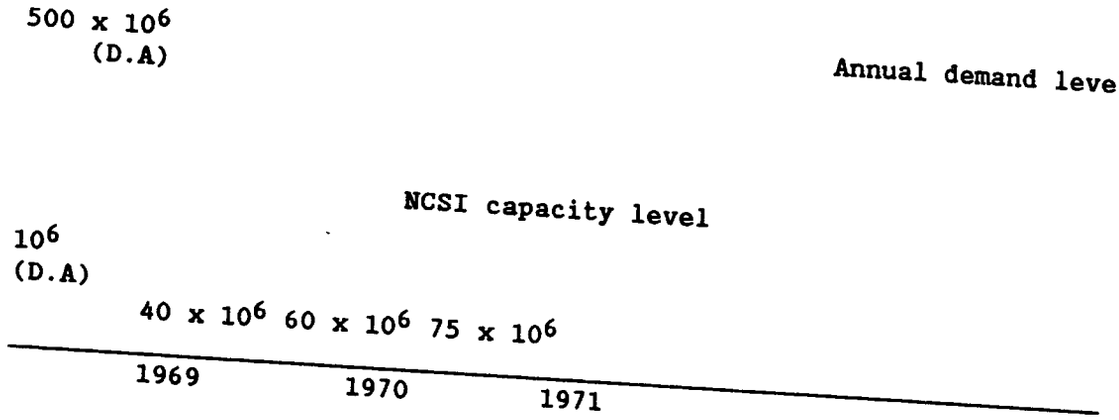
(b) Increased activity in marketing procedures, procurement and storage systems;

(c) Increased forward linkages (engineering/formation) and backward linkages (steel engineering and construction);

(d) Technological developments in design, manufacturing and construction.

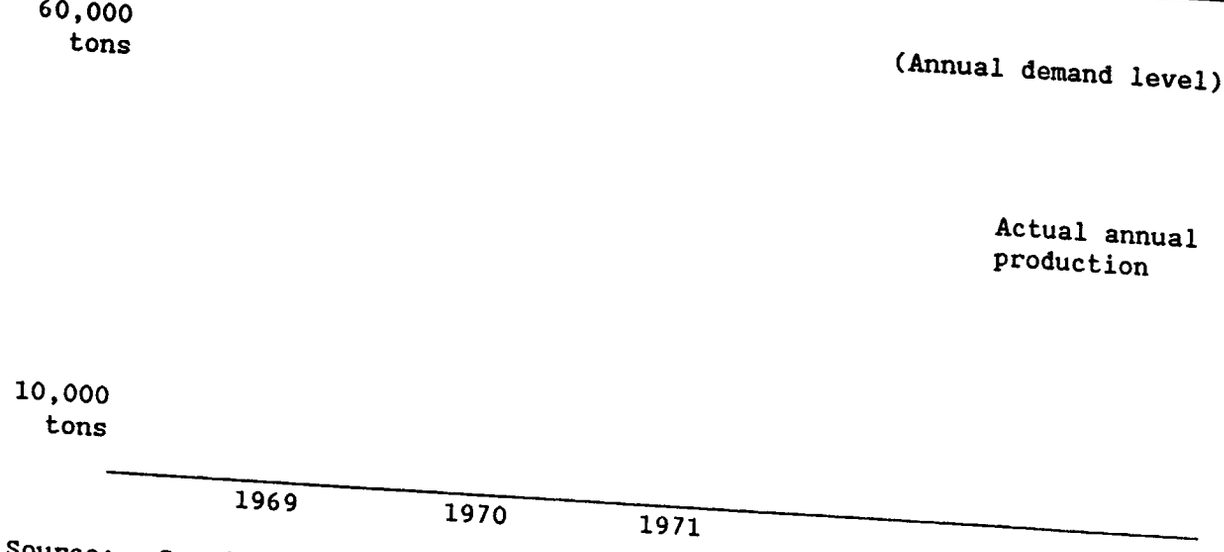
The company also produced many different kinds of complex equipment based on foreign designs, such as heat exchangers, storage tanks and containers used in the sugar and petroleum industry.

Figure 1. Production of and demand for mechanical products and copper equipment (in Algerian dinars)



Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Figure 2. Production of different steel structures in Algeria (in tons)



Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

(c) Third stage (1972-1978)

During this stage investments increased in all sectors of the industry. The demand also increased for all steel products, especially structures. The National Company increased its production capacity, diversified its products and expanded all existing plants and units. New plants were established for manufacturing structures and copper equipment, pulleys, coolers, ingot and steel foundries and equipment used in steel works. With this expansion programme, there was an increase in manpower from 500 to 15,000.

The rapid expansion in activities and facilities led to management complications and owing to the increase in various demands, the national available engineering capabilities were unable to supply all the needs. The authorities' intention to accelerate the industry encouraged the use of "turnkey" contracts and products-in-hand. Actually most of the equipment were imported, although the country had the necessary technical capabilities to manufacture them. The question arose as to whether it was possible to incorporate two contradictory objectives at the same time, i.e., to provide prompt implementation and at the same time integrate the indigeneous inputs for equipment production. There were difficulties because of the unprecedented increase in demand, but the National Company succeeded in developing its technological capabilities and controlled some sectors such as the manufacturing of power station equipment. The company constructed factories and industrial complexes as the main contractor and it prepared the design and the operation of its own factories.

(d) Fourth stage (1978-1985)

The deliberations undertaken during that period concerning the preparation of the fifth development plan (1980-1984) and the development of the industrial production system, the obstacles facing the technology transfer process and the returns of the existing equipment production system concluded that it was necessary to give priority to matters relating to production and management.

The manufacturing industry had concentrated on controlling the huge existing production establishments and defining and implementing a policy for mastering and developing the related technologies.

It had restructured the industrial organizations towards decentralization and therefore provided each production unit with its own engineering design, procurement and marketing facilities plus facilities for undertaking its own R and D (research and development) and training activities.

The national organization decided, since it was producing a large number of various products depending on the demand, to concentrate on certain products or activities in each production line, and at the same time on a programme to master the complex technology for a specific group of products.

The complicated technology of the manufactured products resulted in the establishment of new posts in some units, such as in the quality control unit and the laboratories. The following two technology transfer activities were accomplished in that period:

(a) A contract concluded with an Indian firm for transferring the technology for pressure vessels, heat exchangers, air coolers and pillars;

(b) A contract concluded with a French firm for manufacturing crushers.

The first contract was concluded after long negotiations with the company.

It covers the provision of the technology process equipment and development of the level of the available manpower in line with the needs of the new technology. Technical assistance included sending a number of employees for on-site training. The design and manufacturing of products was undertaken by the national labour force.

The second contract concluded for the crusher equipment technology was signed by an international tender. The National Company preferred not to conclude a licensing agreement and chose instead a contractor able to provide all required designs and the necessary assistance to accomplish all implementation locally and supply other items according to agreed conditions. The supplier also guaranteed the quality of the products.

2.1.2 Structure of the industry

One of the main aims of development planning in Algeria[1/] in the past two decades has been the establishment of a heavy industrial base. Two fifths of investments in the last national economic development plan were devoted to industry. The capital goods industries in Algeria are the most developed in the Arab world and are spread across all the main subsectors in which substantial Arab production exists. They represent 30 per cent of the total production in gross value terms, and slightly more in added value, because local content is comparatively high. The self-sufficiency level in Algeria appears to be nearly 25 per cent on the average in the capital goods categories but with big variations from one product to the other. The Algerian industry is developed towards internal consumption and not export-oriented. The labour and engineering skills, know-how and rate of growth of technological capabilities are still important limiting factors.

The emphasis on steel-making and the metal fabricating industries and the strong interlinkages between them is an important characteristic of this national industry. The weakness in the capital goods industries is mainly because of poor quality control. Heavy industry was, up to 1981, concentrated into a small number of State companies (excluding the steel-making plants). They are mainly the following enterprises:

- SN Metal, manufacturing an extensive range of engineering products and structural steel items;

- SONACOME, producing trucks and buses, agricultural machinery, machine tools and hydraulic products;

1/ See The Development of the Capital Goods Industries in the Arab World, (Arab Industrial Development Organization, 1984).

- SONELEC makes cables, transformers, lifts, consumer products, electronics and telecommunications equipment.

Each of these State companies was split up in 1981 into a number of separate enterprises (national companies) responsible for a specific product category, and they have considerable autonomy in their operations.

The Algerian capital goods production includes all the main industrial sectors; commercial vehicles, tractors and diesel engines are the most important individual subsectors and construction equipment, transformers, railway wagons, pumps and combine harvestors are the second most important elements.

The following capital goods are either manufactured or assembled in Algeria:

- Agricultural equipment: ploughs, discs, harrows, tractors, balers, combine harvesters, trailers, tank trailers and diesel engines;

- Parts for food production and processing equipment, e.g., for bakeries and oil seed crushing, silos, mixers, grinders; pumps of various kinds; material handling equipment; conveyors, rollers, lifts, roller bridges, cranes, construction equipment; dumpers, cement mixers, commercial vehicles; trucks of various types, truck bodywork, utility vehicles, buses, trailers, transformers, circuit breakers, electric cables and wires, electric motors, electricity generators, parts for equipment for mineral extraction and processing, e.g., crushers, graders, conveyors, diggers, parts for agricultural infrastructure, e.g., parts for dams and irrigation such as gates, canal systems; parts for many kinds of industrial plants, notably cement works, brick works and sugar mills.

However, since this survey is concerned mainly with the development of technological capabilities, only the sectors or companies which provided detailed information on their technological capabilities are reviewed.

2.1.3 Automotive industry

The State-owned enterprise (SNVI) specializes in the manufacturing of trucks, tractors, city and inter-city buses in addition to manufacturing commercial vehicle equipment.

This company was established after the restructuring of SONACOME in 1981. The SONACOME was founded in 1967. The activities of SNVI include promoting, production imports and exports, distribution and maintenance of vehicles ad their components. The company has the following manufacturing units:

- The CVI complex for commercial vehicles at Rouiba, which has five production centres plus one unit for supplying energy and maintenance works;

- A cast iron foundry shop, an industrial body workshop (Rouiba);

- The industrial bodyworks production complex located in Tiaret;

- The production unit of industrial bodyworks located in Hussain-Dey.

CVI was established in 1971, with an initial investment of 1 billion Algerian dinars, and a production capacity of 4,550 vehicles per year, of which 4,300 trucks and 250 city and inter-city buses, and a work-force of 4,500 workers. The products include a variety of nine basic types of vehicles; their total weight ranges from 5,450 tons to 26 tons and a surface total weight of 70 tons. The present production capacity is 7,100 vehicles out of which 700 are buses.

The fully integrated cast iron foundry has an annual capacity of 10.000 tons. The industrial bodyworks are separated into two centres: the complex in Tiaret, which has an annual production rate of 10,000 units and the Hussain-Dey unit with 3,000 units per year. That makes an effective total of 13,000 units of industrial bodyworks constructed according to international quality standards, economically and technologically this sector considerably increased the rate of integration of the company's products. Because of its industrial and organizational flexibility, this grand industrial complex constructs 80 types of different bodyworks, divided into two main parts: the bodyworks and bodyworks tractor-drawn vehicles mainly trailers, semi-trailers and vehicle carriers.

The studies and adaptations offices and the technical and methods divisions make it possible for the company to master the technology and the production process plus developing the capability of designing new products or adapting products according to the specific needs of the consumer.

The Tiaret complex consists of four shops for production. These manufacturing shops have 12 assembly lines. The different techniques used consist of: splitting, stamping, machining, steel processing, grinding, spare parts, assembly and tests.

Within the complex there is a mechanical engineering shop, an industrial maintenance shop and a tooling shop.

The mounting units are organized into 10 manufacturing lines. There are in these plants portable cranes for general handling and operators stand-to-stand moving. The secondary handlings linked to each operator's stand use monorails and davits.

The first Algerian commercial vehicle was produced at CVI Rouiba in 1974. After four years (1978) the complex produced its 11,000th vehicle, the actual production that year reaching 6,000 vehicles. In 1983 the actual production reached 7,200 vehicles and at the end of the year the company produced its 45,100th commercial vehicle.

The Tiaret complex has at present an annual production of 10,000 bodyworks. The unit at Rouiba started production with an annual capacity of 10,000 bodyworks (tractors drawn and carried bodies). In 1983 its rate of actual production totalled 11,177 units of equipment. The total manpower of

SNVI was in 1983 approximately 16,000 workers. In the Rouiba centre there are more than 1,470 men, divided into managerial staff, engineers, technicians, specialists and skilled workers.

The enterprise gives special attention to the training of its work-force by allotting over 10 per cent of its investment to training programmes in-house and abroad.

In general it can be concluded that this enterprise has the following industrial objectives.

(a) To establish an industrial base for the manufacturing of products;

(b) To promote this industry through the use and development of techniques for transforming metals (foundry, forging, machining, heat treatment, stamping, mounting, testing);

(c) To provide intensive training for labourers, toolmakers, adjusters, control agents, technicians, and engineers: to reach this target each complex has its own training centre;

(d) To manufacture at a high level of integration;

(e) To develop an important network of distribution and maintenance at the national level.

The Algerian vehicle industry has not developed passenger car production and the development plan does not include any directions with regard to the assembly of passenger cars, though a project has been discussed (since 1971) for the production of cars and four wheel drive vehicles. Commercial vehicle and bus production which is assembled on a substantial scale and the fact that the proportion of national content in these vehicles is high, has stimulated the industry. As for the technology used in the commercial vehicle company, the chassis are based on Berliet designs (Berliet is part of the Renault group), and the vehicles are produced by Deutz diesel engines. The local content accounts for about 70 per cent of the ex-factory value of the trucks, and 75 per cent for the buses. At one time Renault cars were assembled in Algeria but this ended in the early 1970s.

The Algerian Government is negotiating at present to build a commercial vehicle plant, with Renault among the "front runners" for the 5,500 units per year facility. The existing commercial vehicle works at Rouiba will be expanded if an agreement is reached.

2.1.4 Heavy metal fabrication industry

The National Steel and Copper Structures Company is a public sector company. The activities of the two main units within the Company which are concerned with the development of technological capabilities and technology transfer were surveyed. They are:

- The engineering consultancy section;
- The heavy mechanics unit, a production unit in Hussain-Dey.

(a) The engineering consultancy section handles almost all the design and development work for certain types of industrial installations for the following industries: food industries, petrochemical and energy industries, iron and steel and capital goods industries, cement works and brick works, and manufactures a large portion of the equipment required by them. This unit was established in 1971; the main contributions in the last five years were in electric power equipment, transport equipment, construction equipment and iron and steel equipment.

The value of this section's contributions to the production of electric power equipment was around 800 million Algerian Dinars (DA) while for iron and steel equipment it was 700 million dinars.

The number of workers in the unit was 283 as of 1985: the nationality distribution according to job classification was given as follows:

Job	National	Arab	Foreign
Administrators	46		
Engineers	18	1	1
Economists	2		
Technicians	67		
Total	133	1	1
Others	150		

(b) The heavy mechanics unit is responsible for the manufacture of dam and irrigation equipment, sliding bridges and other capital goods equipment such as heat exchangers. At present it also produces a great amount of spare parts used by different industrial complexes, such as the iron and steel complex, the cement factories and electric power stations. These are produced according to specific requirements of clients as an end use and not as an intermediate product.

The unit consumes different locally made and imported resources according to their needs and availability in local markets. It does not have problems with spare parts since it imports what it needs without difficulties.

The factory depends in general on its local capabilities in solving technological difficulties, except for certain sophisticated products for which it usually purchases foreign technology as part of the licence contract; the factory has been able to continue production of such products even after the expiry date of the agreement.

The designed capacity, actual production and sales values of manufactured products for 1983 were given as follows:

Product	Unit	Designed capacity	Actual production	Local sales value (million DA)
Dam/irrigation equipment	ton	495	338	15.8
Sliding bridges	ton	1,320	928	27.8
Others (including heat exchangers)	ton	891	1,021	12.3
Total	ton	2,706	2,287	55.9

The total number of the work-force was not provided, but the distribution of employees according to job description and level of education was given, as shown below:

Job/level	Number	University level	Vocational level
Administration	5	9	
Mechanical engineers	6		
Production engineers	3		
Technicians			176

2.1.5 Electric power equipment industry

Information is provided on only one factory which has been in operation for the past 30 years, though it was renamed the National Cables Industries Company in 1983, during the restructuring period of the national industrial enterprises in Algeria. It has two main manufacturing units for producing electric and telephone cables. Total designed capacity, actual production and sales value for 1983 were given as follows:

Product	Unit	Designed capacity	Actual production	Sales	sales value (DA)
Electric cables	ton	19,950	20,213	20,191	312,979
Telephone cables	ton	3,915	3,304	4,000	80,539
Total		23,865	23,517	34,191	393,518

All products are consumed locally.

The Company has at present an expansion programme for both products. Two new units are being built: the electric cables unit is in the final stage of execution, while they have just initiated work for the implementation of the new telephone cables unit. Other plans include making the required renovations on some of the machines and equipment in the two existing units. Future plans are expected to cover the field of transforming crude copper to wires (8 mm in size of the CATHODS type).

The technology used is from different European sources. The new electric cables unit was purchased from the German Democratic Republic.

The Company's total work-force is Algerian. In 1983 the Company employed 120 employees at the administrative and scientific level and 39 engineers distributed through the main concerned engineering fields.

2.1.6 Machine tools industry

The National Machine Tools Company (ENPMO) is a public sector company with a capital of 106 million dinars. It was set up in 1973-1976, started production in 1977, was established in collaboration with M/S. DIAG of the Federal Republic of Germany for the manufacture of general purpose machine tools. The factory is located in Constantine. It was originally established by the Societe nationale de Construction Mechanique (SONACOME); in 1983 it became a separate entity as part of the restructuring of the Algerian capital goods industries.

The factory was established with a designed capacity to manufacture 1,170 machines per year. The product mix and capacities are shown below:1/

Product	Designed capacity unit/year
Centre lathe	280
Milling machine	150
Bench drilling machine	200
Column drilling machine	100
Shaping machine	40
Power hacksaw	110
Pedestal grinder	250
Universal tool and cutter grinder	40
Total	1,170 units

The production output in 1980 was 700 units per year. The value of production of machine tools during 1980 was 35 million dinars. The local production output during 1980 accounted for 8 per cent of the total consumption; the remaining 92 per cent was imported.

Product	Designed capacity	Actual production	Sales	Sales value in thousand (DA)
Milling machines	150	107	182	58,250
Drilling machines	300	235	298	13,030
Mechanical saws	110	29	149	10,700
(Power Hacksaw)	560	371	629	81,980

1/ Arab Industrial Development Organization, Study on "Development of the machine tools industry in the Arab world" (pre-feasibility study), 1984.

The following information was provided by the authorities concerned on designed capacity, actual production, local sales and sales value for the three main products for 1983.

The factory employs around 500 people. The distribution of employees according to specializations were given as shown below; 26 of them have first degree university level; all of the work-force are nationals.

Job		Number
Administrators		39
Scientists		12
Engineers:	Electric	1
	Mechanic	12
	Chemical	1
	Others	4
Economist		5
Total		74

The plant has relatively modern and sophisticated machines. The facilities accommodate fairly well the wide range of product mix. The design of product mix manufactured are of modern models and the technical features conform to international standards. However the wide range of product mix introduced negatively affected the productivity level. The present level of production is below the design capacity; on average the plant produces at 50 to 60 per cent of its designed capacity. The major problems facing this factory are:

(a) High turnover of trained personnel;

(b) Problems in assimilation of technology;

(c) Difficulties in procurement of imported parts;

(d) Low volume of sales of products due to high selling prices (because of high overheads and high costs).

SONACOME undertook in 1980 a detailed study on future developments of the machine tool industry for the period 1980-1990, in co-operation with the Indian manufacturing firm HMII, with the objective of formulating a plan to expand the existing machine tools industry.

At present two expansion programmes are being initiated by the company:

(a) Expansion of existing plant in Wadi Hamimin;

(b) Establishment of a new unit for cutting tools.

2.1.7 Agricultural equipment industry

The National Agricultural Equipment Company was established as a separate entity on 12 December 1981 after the restructuring of SONACOME. The Company has a capital of 186 million dinars and is located in Seidi Balabbas. This sector was established in Algeria in the early 1970s and started production in 1974. It is a public sector company. The Company produces a variety of agricultural equipment such as ploughs, discs, harrows, tractors, balers, combine harvesters, trailors, tank trailers, and diesel engines.

Algeria has the facilities for the complete production of a tractor from locally produced components. The tractor is Algerian-designed with Algerian-made Deutz engines. Algeria also has the first and only combine harvester plant in the Arab world; it manufactures a 100 hp combine harvester to a CLAAS design. The current output is approximately 500 units per year. The production does not satisfy the local needs and there is a need to increase production level.

The three main products, designed capacity, actual production and local sales in 1983 were as follows, according to national sources:

Product (unit)	Designed capacity	Actual production	sales
Tractors	5,000	6,000	4,344
Harvesters	350	600	750
Diesel engines	9,500	10,000	4,480[1/]

The total sales value for the company in 1983 reached 690 million dinars, excluding the sales value of imported equipment.

The Company employs some 6,438 people, all Algerian nationals except for two mechanical engineers from other Arab countries. The distribution of employees according to jobs and nationality was given as follows:

Job/Nationality	Nationals	Arabs	Non-Arab
Senior management	79		-
Administration	1,456		-
Mechanical engineers	63	2	-
Economists	30		-
Total	1,628	2	-

The company is expanding its manufacture of equipment and plans have been initiated to expand the following:

1/ Other than the diesel engines installed in tractors.

- The official policies which stimulated the trade and services sectors sometimes at the expense of the production sectors including the industrial sector;

- The trend towards decentralization in planning and in implementation which allowed the production centres to make individual decisions with little co-ordination or consultation among themselves;

- Dilution of the responsibility of the Ministry of Industry by attaching some of its projects to other ministries;

- Absence of a well-defined technology policy in Egypt, including laws governing acquisition and transfer of technology to the country;

- Ineffectiveness of organizations concerned with scientific research and technology;

- Brain drain.

(f) The Current Five Year Plan (1982/1983-1986/1987)

One of the objectives of the plan is to correct the imbalance in the structure of the economy, namely to increase industrial production to 15 billion pounds by the end of the plan. This will result in an average annual growth of 9 per cent, which is a more realistic objective than that of the previous National Work Programme which was not achieved. Accordingly, the plan included 453 industrial projects at an estimated cost of 7.6 billion pounds. In addition, the plan emphasized the need to rely to the maximum degree on local capabilities and resources.

During the first year of the plan, the companies of the Industrial Public Sector implemented all the planned projects at a cost of 601 million pounds. In addition, the private sector was permitted to establish 817 industrial projects at an estimated cost of 767 million pounds. During the second year of the plan, the public sector implemented all planned projects at a cost of 661 million pounds. The private sector was given permission to establish 1,190 industrial projects at an estimated cost of 2,124 million pounds.

The share of capital goods and engineering industries in the current Five Year Plan is approximately 13 billion out of 15 billion pounds for the entire industrial sector and 37 billion pounds for the whole plan. This emphasis on developing capital goods and engineering industries is understandable in view of the fact that only 80 per cent of the demand for capital goods and engineering products is satisfied by local production.

2.2.2 Structure of the industry

The industrial structure of Egypt is characterized by the production of basic consumer goods (textiles, shoes, food, beverages and cigarettes) and essential intermediates (building materials, fertilizers, chemicals, paper,

petroleum products and metals) for the domestic market, though an import-substitution economy should place a heavy emphasis on the production of consumer durables and capital equipment. The share of these latter industries remains at below 10 per cent of total industrial output, while the gross value share of intermediate industries has increased to 41 per cent of industrial output in 1978 from 20 per cent in 1947.

Industry as a whole has gained on agriculture. Real industrial output has been averaging an annual growth rate of 12.7 per cent. Manufactured goods production achieved an average increase of 20.3 per cent from 1976 to 1980.

The following tables feature the projected production growth during the year 1982/1983 for both the public and private sectors as well as actual production values performed by these two sectors.

Table 1. Egypt's industrial structure

Categories	1975 Status	1980/1982-1984/1985 expected	Year 2000 scenario
Basic consumer goods	49.7%	30.8%	32.5%
Intermediate goods	40.9%	52.0%	37.5%
Capital and durable goods	9.3%	17.2%	30.0%

Source: Ministry of Industry, Egypt.

The actual real annual rate of national production growth at 1979 constant prices in the years preceding the five-year plan (1979 through 1982) ranged between 5 and 9.1 per cent with an average of about 7 per cent. The expected annual rate of national production growth over the span of the five-year plan is about 9 per cent on the average (at current prices 1981/1982).

Because of the nature of Egyptian industry at present, with 80 per cent of companies State-owned, the majority of the medium or large scale joint ventures are with the public sector. Nevertheless industry, which more than any other sector is handicapped by shifting government policy with regard to wages, pricing and support to the public sector, is growing rapidly and has hosted the largest share of private joint ventures. A good indication,as shown in table 4, is the increase of the share of the private sector in the national industrial production.

(a) The foundry and assemblage workshops producing engines and tractors;

(b) The Balabbas factory for harvesters;

(c) The Mustafa Ibrahim factory for seed sower equipment.

2.1.8 Railway equipment industry

The National Railway Equipment and Accessories Company was established in 1938. It is a public sector company located in Annaba. It produces wagons, flatbeds, tankers and forged works. The two main products are railway wagons and forged works for spare parts and hand tools, used mainly by the iron and steel industry and railways. The Company has plans to expand the forged works. The designed capacity, actual production, local sales and sales value in 1983 were given by the authorities concerned as follows:

Product	Unit	Designed Capacity	Actual production	Local sales	Sales value in million DA
Railroad wagons	number	1,000	800	800	250
Forged works	ton	4,000	3,500	3,500	21
Total					271

The level of education of the work-force is shown below:

Degree	Number
Vocational schools	200
First degree level	50
Masters	2
Total	252

2.2 Egypt

2.2.1 Development of the industry from 1957 to the present

Despite Egypt's long history in its quest for industrialization, dating back to the time of Mohammad Ali, the great efforts in that direction began in the 1950s and have continued since then. These efforts have been reflected in successive government development plans, as follows:

(a) The First Industrialization Programme (1957-1960)

The programme consisted of 502 projects in the petroleum, mining and manufacturing industries at an estimated cost of 330 million Egyptian pounds. The manufacturing projects comprised petrochemicals, food, textiles and engineering projects. The latter comprised 160 projects at an estimated cost

of 97 million Egyptian pounds. In addition the Industrialization Programme called for the establishment of 18 technical training centres at an estimated cost of 2 million pounds to provide technical support to the industrial projects.

Because of the war of 1956, only 105 industrial projects were completed, at a total cost of 87 million pounds. The major engineering projects which were completed included trucks and buses (first stage), railroad cars, transformers, dry cell batteries, electricity motors, passenger cars (Ramsees), washing machines, and cables. In addition five technical training centres were established with programmes in metallurgy, car mechanics, construction and carpentry.

(b) The First Five Year Plan (1961-1965)

The investment allocated to the industrial sector in the Plan totalled 439 million pounds whereas the cost of the projects completed at the end of this period amounted to 404 million pounds. The major engineering projects that began production during this period included passenger cars, diesel engines, agricultural tractors, trucks and buses, steam boilers, telephone cables, machine tools, telephone instruments, electric bulbs, hand tools, motors, fans, railway cars, washing machines, refrigerators and compressors. In addition, a number of training centres were established including at least nine with programmes in metallurgy, car mechanics, and electricity.

(c) The Second Five Year Plan (1965-1970)

The investment allocated to the industrial sector in the plan amounted to 995 million pounds, and in spite of the economic difficulties during this period, it was possible to implement many important projects. In the engineering industry they included air-cooled diesel engines, small motorcycles, expansion in electric bulbs, distribution panels, medium power transformers, expansion in telephone instruments and exchanges, and machine tools. As for training centres, several were established with programmes in metallurgy, electricity and mechanics. One centre was established to prepare future trainers.

(d) The Third Five Year Plan (1970-1975)

After preparation of the plan, it was decided to formulate a 10 year plan (1973-1982) within the so-called National Work Programme. During the period 1970-1972 the total cost of industrial projects which were implemented in all sectors amounted to 236 million pounds.

(e) The National Work Programme (1973-1982)

The objective of the programme was to double the Gross Domestic Product (GDP) within this 10 year period. This in turn called for increasing the ratio of investment to GDP from 13 per cent to 20 per cent. The objective was not achieved because of many factors including:

Table 2. Industrial production growth in the five-year plan 1982/1983-1986/1987 (at 1981/1982 prices in million LE) in Egypt

	Expected 1982/1983			Projected 1986/1987			Growth rate		
	Public	Private	Total	Public	Private	Total	Public	Private	Total
Production value	5,967.1	3,526.4	9,493.5	9,399.7	5,206.6	14,606.3	9.5	8.1	9.0
Value added	1,743.8	921.4	2,665.2	2,825.0	1,434.0	4,259.0	10.4	9.2	9.8
Labour (per thousand)	835.2	627.5	1,462.7	1,055.7	753.5	1,809.2	4.7	3.8	4.4
Wages	997.1	336.6	1,333.7	1,594.4	583.2	2,177.6	10.0	11.5	10.3
LE/Labor productivity	7,144.0	5,621.0	12,765.0	8,904.0	6,910.0	15,814.0	4.4	4.3	4.4
Average wage in LE	1,194.0	536.0	1,730.0	1,510.0	774.0	2,284.0	4.7	7.5	5.9

Source: Ministry of Planning, Egypt.

Table 3. Actual production values (at current prices in billion LE) in Egypt

	1975	1978	1979	1980	1981
Controlled by Ministry of Industry					
- Public sector	1.54	2.39	2.80	3.48	4.21
- Private sector	0.60	1.04	1.36	1.60	1.93
Subtotal	2.14	3.43	4.16	5.08	6.14
Public sector (other ministries)					
Co-operatives and artisanate	1.21	1.38	1.51	1.67*	1.84*
Total national production	3.35	4.81	5.67	6.75	7.98

Source: GOFI - Ministry of Industry, Egypt.

* Preliminary estimate.

Table 4. Contribution of the private sector to total national production in Egypt

1975	
1976	17.9%
1977	29.9%
1978	28.5%
1979	30.3%
1980*	32.7%
	33.1%

Source: Ministry of Industry, Egypt.

* Estimate.

Table 5. Public and private industrial production projected in 1982/1983 (at 1981/1982 prices in million LE) in Egypt

	Expected 1981/1982			Projected 1982/1983			Growth rate		
	Public	Private	Total	Public	Private	Total	Public	Private	Total
Cotton ginning and baling	21.4	-	21.4	22.9	-	22.9	7.0	-	7.0
Mining and quarrying									
Mining	12.9	-	12.9	13.2	-	13.2	2.3	-	2.3
Quarrying	14.0	9.3	23.3	14.3	10.2	24.5	2.1	9.7	5.2
Other materials	24.0	4.4	28.4	24.5	4.9	29.4	2.1	11.4	3.5
Total	50.9	13.7	64.6	52.0	15.1	67.1	2.2	10.2	3.9
Industries									
Foodstuffs	981.0	147.0	2451.0	1039.9	1540.6	2580.5	6.0	4.8	5.3
Beverages	112.6	140.4	253.0	117.8	176.0	293.8	4.6	25.4	16.1
Tobacco	569.1	7.9	577.0	609.0	8.4	617.4	7.0	6.3	7.0
Textiles	1310.6	358.4	1669.0	1429.8	381.0	1810.8	9.1	6.3	8.5
Ready-made garments and shoes	80.5	801.5	882.0	84.9	853.0	937.9	5.5	6.4	6.3
Wood products	14.6	157.4	172.0	16.1	174.9	191.0	10.3	11.1	11.0
Pulp and paper	88.0	3.0	91.0	89.3	3.3	92.6	1.5	10.0	1.8
Printing and publishing	42.1	57.9	100.0	50.4	62.9	113.3	19.8	8.7	13.4
Leather products	12.2	92.8	105.0	14.8	111.2	126.0	21.3	19.8	20.0
Rubber industries	47.2	2.8	50.0	50.8	3.1	53.9	7.6	10.7	7.8
Chemicals	504.0	103.0	607.0	597.7	113.2	710.9	18.6	9.9	17.1
Coke products	67.0	-	67.0	73.0	-	73.0	9.0	-	9.0
Non-metallic products	356.4	75.6	432.0	399.6	86.4	486.0	12.1	14.3	12.5
Basic metallic products	671.0	53.0	724.0	740.8	62.4	803.2	10.4	17.7	10.9
Other metallic products	143.0	77.0	220.0	143.2	85.4	228.6	0.1	10.9	3.9
Non-electric machinery	66.3	11.7	78.0	67.6	13.0	80.6	2.0	11.1	3.3
Electric machinery	287.7	32.3	320.0	297.0	35.6	332.6	3.2	10.2	3.9
Automotive industries	333.4	23.6	357.0	345.0	24.8	369.8	3.5	5.1	3.6
Other industries	208.1	44.9	253.0	246.5	47.5	294.0	18.5	5.8	17.2
Total industries	5894.8	3513.2	9408.0	6413.2	3782.7	10195.9	8.8	7.7	8.4
Grand total	5967.1	3526.9	9494.0	1488.1	3797.8	10285.9	8.7	7.7	8.3

Source: Ministry of Planning, Egypt.

The main companies which are currently active in the capital goods industry are listed in table 6 below.

Table 6. Companies in the capital goods and engineering industries in Egypt

Name of Company	Ownership	Main Products
(a) Metallic product		
Engineering projects for Steel Works (STEELCO)	Public sector	Metallic construction, structures, high wenches, heavy trailors, electricity towers, sewerage equipment
Egyptian Company for Metallic Construction (METALCO)	Public sector	Metallic construction, structures, tower wrenches, electricity towers, bridges
Misr Engineering and Tools Company (MECAR)	Public sector	Metallic construction, heavy and half trailor structures, cement mixers
The Boilers and Pressure Vessels Mfg Company	Public sector	Steam boilers, pressure vessels
Arab contractors	Public sector	Metallic construction, structures, construction, sewerage equipment, bridges
Egyptian Iron and Steel	Public sector	Metallic construction, metallic structures
Construction and Industrial Services	Public sector	Light metallic constructions and all electrical and industrial construction
Ferro Metalco	Joint	Heavy metallic construction, metallic structures, bridges, factory equipment
Al-Nasr for Steel Pipes	Public sector	Electric rods (medium and small)
(b) Non-electrical equipment		
Helwan for Machine Tools	Public sector	Machine tools, bakery ovens, mill equipment
Helwan for Diesel Manufacturing	Public sector	Diesel engines, sewerage equipment, engine parts
HAWASH	Private sector	Machine tools manufacturing
Zeki Faraj	Private sector	Plastic machine manufacturing

Table 6 (Cont'd)

Name of Company	Ownership	Main Products
Abdul-Aziz Al-Shourbajie	Private sector	Plastic machine manufacturing
Prefabco - Hijazi	Private sector	Prefabricated buildings and stores
(c) Electrical equipment and tools		
El-Nasr for Electrical Transformer Manufacturing	Public sector	Electricity transformers
Egyptian-German for electrical products (Siemens Concerters)	Joint	Electricity boards, keys, knives, current transformers.
Arab Contractors/ Electrical Industries	Joint with Brown Bereri	Transformers, control panels, electrical equipment
Electric Cables Production	Public sector	Electricity cables
Helwan for Non-Iron Industries	Public sector	Conductors
El-Nasr Boilers Company	Public sector	Heat exchangers
REFCO	Joint	Solar heaters
Arabian HETCO	Joint	Solar heaters
Helwan for Diesel Manufacturing	Public sector	Electricity generators
(d) Transportation equipment		
Nasr Automotive Mfg. Company (NASCO)	Public sector	Cars, lorries, buses, trailors
Light transportation Vehicles	Public sector	Microbuses, vans, semi-trailors, motorcycles bicycles
The Egyptian Company for Railway Equipment (SIMAF)	Public sector	Railway wagons (passenger and shipping), tram compartments
Arabian American Company for Cars	Joint	Jeep compartments, power wagons, cars
YAUAT and Transportation Equipment	Public sector	Spring and coils, railway wagons,brakes and clutch parts

Source: Ministry of Industry, Egypt.

2.2.3 Automotive equipment industry

The first real effort to enter into the automotive industry was made in 1959 when the Nasr Automotive Manufacturing Company (NASCO) was established in Helwan to manufacture trucks and buses. Later the company expanded its activities and started to manufacture agricultural tractors, passenger cars and trailers. The company has about 13,000 employees and in the year 1982/1983 the value of its activities amounted to 276 million pounds. The production output of the company in 1982-1984 is shown in table 7.

Table 7. Production of Nasr Automotive Company (NASCO) in Egypt

Product	1982/1983	1983/1984
Trucks	2,678	3,350
Buses	702	750
Agricultural tractors	3,266	3,900
Trailers	364	400
Passenger cars	23,555	23,835
Diesel engines, etc.	7,000	7,500

Source: Ministry of Industry, Egypt

The most important contracts which the company concluded for acquiring foreign technology include the following:

(a) Trucks and buses

In 1959 an agreement was concluded with Kliknor Humboldt Duetshe Company in the Federal Republic of Germany to assist in the manufacture of 5 to 8 ton trucks and buses. The designed capacity was 4,900 units per annum, and the project was planned to be implemented in 8 one-year phases. The objective was to reach a local added value of 90 per cent : 47 per cent at the company's factories and 43 per cent at the factories that supply the intermediate parts and components. It was found more economical to continue importing from abroad the remaining 10 per cent which include the speedometers, the fuel pumps, and other specialized and standard parts.

The implementation of the project was delayed considerably owing to financial difficulties. However, at the end the local added value reached about 70 per cent of which 40 per cent was achieved inside the company's factories and 30 per cent in the feeder industries which consist of about 150 companies supplying around 2,000 different parts. The company was also able to absorb the acquired technology and to adopt it to local conditions. As one example, the local engineers and technicians successfully modified the body of the bus without any foreign assistance.

(b) Passenger cars

In 1961 an agreement was concluded with the Fiat Company of Italy to assist in the manufacture and assembly of passenger cars. The designed

capacity was set at 12,000 cars per annum and the objective was to provide 68 per cent of the parts locally, i.e., 46 per cent at the company's factories and 22 per cent from other domestic companies.

Other agreements were later signed with Fiat Company to assist in manufacturing new car models, and when Fiat Company ceased producing certain car models, NASCO concluded an agreement with the Polmworth Company of Poland which was producing those models.

The passenger car project failed to achieve its objectives, and remained in fact an assembly operation in which local manufacturing did not exceed 25 per cent. This is attributed to the following reasons:

- Financial difficulties faced by the project;

- Policies of NASCO which gave top priority to manufacturing trucks, buses, and tractors, rather than passenger cars;

- Limited size of the market which does not enhance integrated production;

- Inadequate feeder industries especially in regard to plastic, rubber, and aluminium parts as well as electrical components.

(c) Agricultural tractors

In 1961 an agreement was concluded with the Invest Import Company (IMR) of Yugoslavia to assist in the manufacture of 50-60 horsepower tractors, with water-cooled engines. The designed production capacity was set at 3,000 units per annum, and the objective was to manufacture 90 per cent of all parts locally, within and outside the factory. Ten years later only 30 per cent of the parts were locally manufactured. The project faltered and NASCO stopped dealing with its Yugoslav counterpart; in spite of many improvements introduced by the Company to make the tractor more suitable to local conditions and needs, the local tractors were not accepted by the farmers. The Company then concluded an agreement with a Romanian Tractor Company, Universal, to manufacture UT 65 hp tractors. Accordingly 50 per cent to 60 per cent of the domestic demand is satisfied by locally manufactured tractors with an integration rate of about 5 per cent. The rest is satisfied by importing assembled tractors which, contrary to imported tractor parts, are exempted from custom duties. In addition the Company produces other tractors with the assistance of the Massey-Ferguson Company of Great Britain.

Future plans call for the establishment of a new factory in Alexandria to manufacture initially SKD tractors and then CKD tractors with the assistance of the Massey-Ferguson Company. The planned production is about 5,000 units per annum.

(d) Trailers

An agreement was concluded in 1961 with the PLUMHART Company of the Federal Republic of Germany to assist in manufacturing trailers of different loads up to 26 tons. The designed production capacity was set at 2,000 units

per annum. The project was implemented in parallel with the truck and bus project. The actual production capacity reached 2,000 units per annum, and the ratio of parts manufactured locally reached 70 per cent.

Besides NASCO, other companies are active in the automotive industry. The Egyptian Light Transport Manufacturing Company (ELTRAMCO) manufactures pick ups, vans, and micro buses. The Company relies on its own capabilities in manufacturing the body and the upholstery as well as doing the paint and piping works, and imports the chassis, engine and mechanical and electrical components. The Misr Engineering Tools Company has also developed designs for many types of heavy industrial trailers and semi-trailers. The Company imports the parts which are not economical to produce locally such as axles and brakes and relies on its own capabilities otherwise. In addition the Arab American Motors (AAM), a joint venture between American Motors of the United States and the Arab Organization for Industrialization, was established to assemble jeeps and other four wheel drive vehicles for the domestic market and for export. The planned capacity is 12,000 units per annum. However, it is not certain whether this project will be really implemented.

(e) Components

- Diesel engines: They are used mainly in conjunction with welding generators, stand-by generator sets, and irrigation pumps.

In the Helwan Diesel Company, the designs are those of the Austrian Professor Listz, and they are manufactured in two categories: 11-120 hp (1-6 cylinder)and 30-150 hp (2-6 cylinder) with the common cylinder dimensions. Forgings, castings and crankcases are supplied by another local company. Other standard items such as injection pumps and electrical equipment are imported. The production capacity is 4,000 units per annum and it is planned to increase it to 6,000 units per annum.

In the Shubra Company, single cylinder, horizontal strokes, Deutz licensed of 6, 10, 15 hp engines are manufactured. All components are made in the same plant except the injection pumps and some electrical equipment. The production capacity is 1,500 units per annum and may be increased to 2,500 units per annum in the future.

- Batteries, radiators, tyres are manufactured in the country. Information regarding the product types and production capacities is not available.

The development of the automotive ancillary industry is highly encouraged to cope with the local demand. Consequently licence and/or joint venture agreements are negotiated or under negotiation for the following projects.

- Licence and "know-how" agreement for the assembly and production of 35,000-45,000 medium-size cars per year between the Nasr Automotive Company (NASCO) and some international companies;

- Joint venture project or technical assistance for the assembly and production of small passenger cars at an annual rate of 60,000 cars in two shifts in 1990, to be increased to 100,000 cars in two shifts in 2000;

- Licence, "know-how" and technical assistance agreements to modernize and extend the product range of NASCO and to increase its production capacity up to 11,550 trucks and buses to produce engines, gearboxes, axles, frames, drivers' cabins and bus bodies. The local content is estimated to reach 60 to 70 per cent;

- Joint venture project for the assembly and production of medium and heavy trucks and buses in Egypt (annual rate 4,800 units);

- Joint venture project for the production of light and medium trucks at an annual rate of 14,500 units in the year 1990;

- Joint venture project for the assembly and production of 5,400 units of trucks and buses to be increased to 18,000 units by the year 1990. A majority of the paid up equity is to be shared between the General Motors Company and Isuzu Motors, with the remainder held by private Egyptian and Arab investors;

- Joint venture or licensing arrangement for the production of 6,000 agricultural tractors and implements with NASCO has been under negotiation;

- Joint venture between Egyptian and foreign partners for the production of 2,000 agricultural tractors and diesel engines;

All these projects will be very beneficial to the Egyptian automotive industry.

The production of each project has to reach at the end of the first stage a percentage of local content not less than 40 per cent inside and outside the plant and gradually increase to reach 60 per cent at the fifth year from date of start of production.

In order to increase the local content all of these projects will be eager to buy the maximum possible number of locally manufactured parts.

The start of production for the needed parts is among the proposed projects for feeding industries needed for automotive industries.

The proposed projects for the feeding industries include the manufacture of the following products:

1. Air filters
2. Fuel filters and fuel filter elements
3. Electric equipment
4. Radiators
5. Rubber products
6. Hydraulic brakes
7. Shock absorbers

8. Tyres
9. Injection pumps
10. Malleable cast iron
11. Clutch and clutch discs
12. Oil coolers
13. Electric cables
14. Oil pumps
15. Standard parts
16. Plastic parts
17. Longitudinal members of chassis frame
18. Oil filters
19. Injectors and nozzles
20. Exhaust silencers
21. Air brakes
22. Propeller shafts
23. Disc wheels
24. Instruments and indicators.

2.2.4 Construction equipment industry

Construction equipment is normally divided into seven categories:

1. Crawler dozers
2. Crawler loaders
3. Wheeled loaders
4. Hydraulic excavators
5. Loader backhoes
6. Motor graders, scrapers, and off-highway dump trucks
7. Cranes.

Production of construction equipment in the period 1977-1981 is shown in table 8.

Table 8. Production of construction equipment in Egypt

Type of equipment	1977	1978	1979	1980	1981
Cranes (tons)	94	213	119	108	134
Concrete mixers (units)	55	77	33	38	18
Fork lift trucks (units)	5	24	4	-	-
Roadsters (units)	39	30	46	-	-

Source: Ministry of Industry, Egypt.

2.2.5 Electric power equipment industry

The domestic production of electric power equipment during the period 1972-1983 is shown in table 9. It indicates that the main products are:

(a) Transformers. These are distribution transformers with capacities up to 1,600 kVA and line voltage up to 11 kV. They have been produced by the El Nasr Company under the licence of the Trafo Union of the Federal Republic of Germany. The technical assistance agreement between the two companies includes:

- Training El-Nasr employees in the design of distribution transformers;

- Furnishing El Nasr with designs and technical documents;

- Making available specialists from the Trafo Union as required by El Nasr;

- Supplying raw material and parts upon request;

The El Nasr Company concluded a new technical assistance agreement with France Trasfo. The agreement includes all the clauses of the Trafo Union agreement and in addition calls for France Trasfo to assist in the layout of a new factory and in planning its production. The new factory, which is scheduled to start production this year, will produce power transformers up to 66 kV.

In addition it will increase the production output of distribution transformers from about 60 per cent of the national demand at present to cover the entire Egyptian market with extra output for export.

(b) Outdoor disconnecting links with drop-out fuses. The El Nasr Company has been producing these 11 kV links under the licence of Brush Power Company of the United Kingdom. The technical assistance agreement between the two companies includes the following provisions:

- Training of engineers and technicians;

- Assistance in the design and presentation of technical documents;

- Supply of parts and material upon request.

(c) Welding transformers. The El Nasr Company also produces 400 ampere single phase welding transformers. The company produced 480 units in 1983. Some material parts are imported while others are procured from the domestic market.

(d) Electrical cables. The Egyptian Electric Cables Company concluded an agreement with the International Organization for the Development of Manufacturing Cables and Parts to provide it with technical assistance and to train its engineers and technicians on site and abroad. The main products of the company are:

Table 9. Domestic production of electric power equipment, 1972-1983, in Egypt

Type of equipment	Specification (KV & MW)	Unit	Annual production												Local content (per cent)	Local manufacturers
			1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983		
Distribution transformers	11 KV	MVA	300	415	392	477	509	619	589	686	794	787	981	1089	25	Elmaco
M.V outdoor D.L.	11 KV	No.	-	-	-	-	-	-	-	-	-	1097	2595	1714	70	Elmaco
M.V cables	11 KV	Ton	6280	3637	4254	6466	6154	7867	7174	6631	7276	8071	9486	10865	70	Egypt Elect Cab
L.V cables	0.38 KV	Ton	5672	4583	4269	6422	6915	5236	8564	9572	11106	11577	12553	12242	75	Egypt Elect Cab
Al. and SCA conductors	All volt.	Ton	2422	3291	2609	2189	3525	3996	3417	4063	5125	6182	4955	6000	60	Helwan Co.
Steel towers	All volt.	Ton	1000	1000	1000	2000	2000	2000	3000	3000	3000	4000	4000	4000	100	Melalco.
Steel poles	11 KV	Ton	1000	1000	1000	2000	2000	2000	2500	2500	2500	3000	3000	3000	100	Melalco.
Steel towers	All volt.	Ton	-	-	-	3600	3600	3600	4000	4000	4000	4500	4500	4500	100	Sleclco
Concrete poles	11 KV	Ton	5300	5300	5300	7200	7200	8100	9300	10200	11400	12500	12500	12500	80	Slgwart
Switchboards with.B	11 KV	Colls	.	.	-	-	-	-	-	1152	452	873	246	608	45	Egemac
Kiosks	11 KV	No.	-	-	-	-	-	-	-	267	393	634	521	381	50	Egemac
Kiosks	11 KV									-	-	-	700	640	50	Arab
Switchboards with L.B.S.	11 KV									38	404	417	305	351	45	Egemac
Switchboards with L.B.S.	11 KV										-	-	600	580	45	Arab
L.V switchboards	380 V									557	285	1839	2327	3421	55	Egemac
L.V switchboards	380 V										-	-	1249	1592	55	Arab
Current and potential transformer	11 KV	No.									-	730	760	2760	100	Egemac
Support insulators	11 KV	No.										450	3800	7800	100	Egemac

Source: Ministry of Industry, Egypt.

- Medium-voltage armoured cables;
  Paper impregnated cables;
  Cross link polyethane cables whose production started in 1981 and has been expanded to meet increasing demand.

- Low voltage cables;
  PVC cables.

- Telephone cables whose production in 1983 was 5,086 tons;

- Insulated wires whose production reached 6,086 tons in 1983;

- Varnish insulated wires with an output of 787 tons in 1983.

(e) Other electrical products

The Egyptian German Company for Electrical Products (EGEMAC) concluded a licence agreement with the Siemens Company of the Federal Republic of Germany. According to the terms of the agreement, the Siemens Company provides EGEMAC with detailed designs and working drawings of equipment as well as complete components such as switchgear equipment. The Company buys material in the domestic market whenever it is available to maximize local added value. The main products of EGEMAC are:

- Medium voltage switchboards

- Kiosks

- Medium-voltage ring main switchgear

- Low-voltage switchboards

- Cast resin current and potential transformers

- Cast resin support insulators.

Another company, the Arab Contractors for Electrical Industries (ARABB), concluded a licence agreement with the Brown Boveri Company to manufacture switchboards and their components. Accordingly, the Brown Boveri Company supplies all technical data, know-how, production planning and trains ARABB engineers and technicians in its factories. The Company imports switchgear components from the Brown Boveri Company and relies on the domestic market for procuring other materials. Although some materials such as sheet steel and galvanized bolts are not readily available from domestic suppliers, the Company is forbidden by law to import materials which are produced domestically.

(f) Linkages with other capital goods industries

The electric power equipment companies use all material manufactured in the domestic market. They obtain steel from the Egyptian Iron and Steel Company which produces about 1.2 million tons of steel per annum, and

aluminium from the Misr Aluminium Company, which produces about 160,000 tons per annum. Electrolytic copper is produced by the Egyptian Copper Company at the rate of about 5,000 tons per annum which covers a small portion of the demand of the electric power equipment industry.

Existing casting facilities such as the General Company for Metals at El Tibbin (south of Cairo), can provide the electric power equipment industry with its needs. The same is true with regard to forging where present facilities comprise the El Nasr Forging Industries.

(g) Linkages with sources of technology

It has been shown that originally licensing was the means adopted for technology transfer. Later on another modality, joint venturing, was also utilized. At any rate, the foreign companies, in addition to supplying the designs and production documents, invariably conduct training programmes for the local staff.

At the domestic level, most of the research is done at the universities and specialized institutions. These include:

- The National Research Centre which was established in 1948 for the development of applied research and to tackle problems encountered by the industry;

- The Centre of Industrial Design which was set up by the Ministry of Industry to promote design work required by the Egyptian industries;

- The High Voltage Research Centre which belongs to the Ministry of Electricity and Energy. This Centre is involved in high voltage testing required by the electric power equipment industry.

(h) Constraints in the growth of the industries

A major constraint impeding the development of the electric power equipment industry has been the size of the market which is not large enough for many products to justify domestic production. Thus, in order to establish viable industries a part of their production must be set for export. This has not been possible because of keen competition in the world markets and the lack of economic co-operation with other developing countries. Moreover, the terms of licence agreements concluded with foreign manufacturers did not include clauses and conditions that enhance the export position of the domestic companies.

Financing has been another constraint. Because private capital has not been actively participating in large industries, the burden of establishing and financing these industries has been borne by the Government. Even with their high priority, they may not be established because the Government does not have the necessary foreign exchange.

- Increasing the local added value;
- Improving the quality of the product;
- Providing assistance in exporting the products;
- Training the local staff;
- Offering technical advisory service.

The main technology contracts which the company concluded with foreign sources pertained to the following:

1. Workshop machine. A contract was concluded with the Promass Export Agency of the Soviet Union in 1958 to assist in the production of 150 general purpose milling machines, 270 drilling machines, and 300 general purpose lathes per annum. The contract included a provision for assisting in the manufacture of some components and parts other than certain special or standard components such as motors and cooling pumps. The first lathe was produced in 1964, and the designed capacity was reached in 1969.

The company encountered many problems. For one thing the feeding industries during the first phases of the project were not able to provide the necessary components, castings, and forgings with the required specifications. Consequently the local market did not readily accept the product, and thus inventory increased and sales decreased. The company eventually rectified this situation by relying on its own efforts and the experience it gained in manufacturing the product. The technological capabilities which it was able to develop include the following:

- The capability to design the product and the production machines;
- The capability to plan and organize production and to deal with the feeding industries to improve the quality of components and parts they manufacture.
- A centre to train the necessary work-force;
- Co-operation with research institutes and universities to solve problems and improve utilization of computers in various aspects of the project.

2. Modern and automatic lathes. The contract was concluded with the Farser Company of the Federal Republic of Germany in 1980 to assist in producing lathes. The contract which is still active has the same objectives as the workshop machines contract.

3. Modern milling machines. The contract was concluded with the Frenser and Fleder Company of the Federal Republic of Germany in 1963. The contract has the following objectives:

- To assist in manufacturing a new product;

- To provide the components and parts and to assist in assembling the final product;

- To increase the local added value;

- To improve product quality;

- To utilize local materials and components;

- To train the local work-force.

4. Automatic bakery machines. The technological capabilities which were already developed in the company enabled it successfully to negotiate and obtain the technology it needed, and to move on to manufacture new products. A major example of this is the automatic bakery machine. The company did not want to rely completely on the machine tools industry. Because of economic difficulties many foreign manufactures moved into developing countries either through branch manufacturing or by selling their products at very low prices. The company thus sought a new product which would satisfy the following conditions:

- A product which could be produced locally with the available technological capabilities;

- A product for which the demand would be sufficient to make its production viable;

- A product which depends on available capabilities to the extent that 80 per cent of it can be manufactured within the factory. For the remaining 20 per cent, the company concluded a technology contract with a major manufacture of similar machines;

- A product which could be introduced gradually, without adversely affecting the main production line, i.e., machine tools.

The company was able in 22 months to design, manufacture, assemble and produce the prototype, which was tested and accepted by the Government agencies concerned. The success which the company experienced in the automatic bakery machines project encouraged it to consider manufacturing other products such as agricultural machines by relying on its own technological capabilities in design and production.

2.2.7 Summary of the capital goods industry

The following table 10 gives a rough identification of capital goods. The 'O' sign denotes positive availability and the X sign denotes negative availability. The signs 'A' through "I" represent levels of availability, existence, as shown below:

(a) Exists in a separate industry, i.e., factory, plant, etc.;

(b) Exists as an activity in more than one plant in a general activity;

(i) Stimulants for the growth of the industry

The Government at present is doing its utmost to protect the domestic industries. According to the Act of Rationalization of Imports it is forbidden to import any product that is manufactured locally unless the local production is not sufficient to satisfy the demand. In addition the Government gives priority to the needs of industry, including investments to establish new factories and to expand existing ones. The Government will continue the trend established in the Five Year Plans, namely to encourage the private sector to invest in industrial projects.

The market constraint which has impeded the development of the industry will become less severe. First, the Government is striving to conclude bilateral and regional agreements with other Arab countries for technical and economic integration, e.g. joint projects in Egypt and the Sudan. Secondly, the domestic demand for electric power equipment will increase in the future to the level at which integrated production centres will become viable.

2.2.6 Machine tools industry

(a) Historical background

The development of the machine tools industry, in general, depends on the availability of capabilities in design and metal research in addition to various specialized production capabilities for manufacturing standard components and parts as well as forgings and castings. All these components and parts are then assembled and tested to obtain the final product.

Historically, the industry passed through four distinct phases. In the first phase (1805-1882), the Government emphasized economic development, both in agriculture and in industry. Foreign experts were invited to Egypt and many Egyptians were sent abroad for training. In addition, a number of specialized scientific and technical research institutes were established. As a result of all those efforts, many types of machine tools and equipment were manufactured both for civilian and military applications.

During the second phase, from the British invasion of Egypt in 1882 up to the beginning of the Second World War in 1939, industrial development slackened and the Egyptian economy became dependent on exporting agricultural products, mainly cotton. Thus industry, including machine tools manufacturing, was neglected. The only activities pertained to the establishment of repair and maintenance workshops for railroads, ships and military equipment.

The third phase extended from 1939 to the mid-1950s. During the war years it was impossible to import spare parts and so efforts were concentrated to manufacture them locally. After the war ended, much left-over military equipment and parts, such as motors, metal structures and tanks, were used to produce some equipment in a primitive way without adhering to engineering or technical principles. Moreover, some foreign-owned workshops produced certain machine tools such as lathes, milling machines and small presses. Production was made to order.

During the fourth phase, from the mid-1950s up to the present, great emphasis has been placed on manufacturing machine tools. Many projects were included in the successive development plans, and a number of contracts were concluded with foreign companies to assist in manufacturing certain machine tools and major components.

Because machine tools encompass a wide range of products of varying technological complexity, it is necessary to distinguish between the various products in order to assess the feasibility of manufacturing them locally. Thus, with respect to the general purpose machines and equipment such as workshop machines , medium-pressure boilers and vessels, medium-size cranes and some contracting machinery, technological development at the international level has been somewhat slow. This factor ought to enable developing countries like Egypt to succeed in manufacturing these machines. In fact many countries, including India, China, the Republic of Korea, and Mexico, made substantial progress in this respect.

The situation is different with respect to special purpose and complex machines and equipment such as modern textile machines, numerically controlled workshop machines, high-pressure boilers and pressure vessels. In this industry, international competition is very keen especially since the emergence of Japan as a major competitor. This in turn forced many foreign manufacturers to merge and made it difficult for developing countries like Egypt to establish this industry without the assistance of multinational companies which dominate the industry at the international level. In addition, it is necessary for developing countries to build the required technological base to absorb and adopt the imported technology, and to establish industrial capabilities to supply the necessary forgings, castings and major standard components and parts.

(b) Major accomplishments of the industry

One of the major companies in the industry is the Helwan Company for machine tools. The company was established in 1958 as a military factory with Soviet technical assistance for manufacturing some general-purpose workshop machines. In the early 1970s the factory became independent and continued to manufacture general-purpose workshop machines and some military equipment. In addition it introduced other products such as automatic bakery machines, and is currently considering introducing flour mill machines.

The company obtains the technology it needs from local sources (research institutes, universities and its own research and development units) as well as foreign sources. Its criteria for selecting the technology include economic, technical and investment factors in view of available raw materials, human resources and finances. The source of technology is chosen on the basis of many factors which include the reputation, experience and conditions of the source of technology as well as its willingness to assist the company in absorbing and adapting the technology. The elements of the transferred technology comprise the following:

- Assistance in increasing ongoing production as well as manufacturing new products;

Table 10. Capital goods and engineering equipment in Egypt

	a	b	c	d	e	f	g	h	i	j
Foundry facilities	o	o	o	x	o	o	x	x	o	x
Forging facilities	o	o	o	x	o	o	x	o	o	x
Machine tools	0	x	x	x	x	o	o	x	x	x
Production technology	x	o	o	x	o	o	x	x	o	x
Methods of machining	x	o	o	x	o	o	x	x	o	x
Design of tools	o	o	x	x	x	o	x	x	x	x
Design of fixtures	x	o	x	x	x	x	x	x	x	x
Heat treatment	x	o	o	x	x	o	x	x	x	x
Process machinery (petrochemical)	x	o	x	x	x	o	o	o	x	x
Process machinery (fabric)	x	x	x	x	x	x	x	x	x	x
(Forming industry)	x	o	o	x	x	o	x	x	o	x
(Welding industry)	x	o	o	x	x	x	x	x	x	x
Diesel engines	o	o	x	x	x	o	o	o	x	x
Electric motors	o	o	x	x	x	o	o	o	x	x
Switch gear	o	x	x	x	x	o	o	o	x	x
Control gear	x	x	x	x	x	o	x	x	x	x
Generators	x	x	x	x	x	x	x	x	x	x
Turbines	x	x	x	x	x	x	x	x	x	x
Transformers	o	x	o	x	x	o	o	o	o	x
Cables	x	o	o	x	x	o	x	o	o	x
Casting (ferrous)	o	o	o	x	x	o	x	x	o	x
Casting (Non-Ferrous)	o	o	o	x	x	o	x	x	o	x
Forgings	o	o	o	x	o	o	x	x	o	x
Machining and machine shop equipment	x	o	o	x	x	o	x	x	o	x
Fabrication welding	x	o	o	o	x	o	x	x	o	o
Fabrication stamping	x	o	o	x	x	o	x	x	o	x
Fabrication pressing	x	o	x	x	x	o	x	x	x	x
Fabrication heat treatment	o	o	o	x	x	o	x	x	o	x
Design engineering	o	o	x	x	x	o	o	o	x	x
Electrical engineering	o	o	x	x	x	o	o	o	x	x
Rolling mills	x	x	x	x	x	x	x	x	x	x

Source: Ministry of Industry, Egypt.

(c) Present production covers basic need (sizes, models, powers capacities, etc.);

(d) Present production covers total spectrum of needs (sizes, models, power capacities etc.);

(e) Present production covers quantitative needs and no importation is allowed.

(f) Extensions are planned;

(g) Industry working with international licence/"know-how" agreement;

(h) Industry was originally working with an international licence;

(i) Local technology and design capabilities sufficient for basic needs;

(j) Local technology and design capabilities sufficiently sophisticated and comparable and competitive with international manufacturers.

The matrix presented may be considered indicative only and serves to project a rough picture of the capital goods industry in Egypt at the moment. From the matrix the following may be concluded:

1. According to the classification of capital goods used in this report the country is actively engaged in manufacturing nearly all items of capital goods. There is a basic production of machine tools, tools and fixtures, prime movers, diesel engines, electric motors, switchgear, transformers, etc., as well as the basic technologies of casting, forging, welding machining, etc.

2. However, these basic industry groups exist, sometimes as separate industries, i.e., in one integral unit (company) or as activities (shops) within miscellaneous industries. For example, there is a company for forgings, the Nasr Forging Company, but there are also a number of forging activities in numerous other enterprises. In some cases the opposite is true and there is no main industrial body, e.g., in machining. Although there are some separate large workshops for machining of mechanical products, this activity is included in all major enterprises. The private and small scale sector also has thousands of machine shops which make machine parts and components and effect repairs.

3. The present industrial structure is such that basic needs are usually covered as far as sizes,models, power and capacities. For example, the transformer industry produces distribution transformers of 50 kVA to 1,600 kVA which are the main units used on the 11,000/380/220 V network for cities; larger units such as 5,000 kVA, 10,000 kVA up to 40,000 kVA are included in future plans owing to the economies of scale and complicated technologies involved. Only in some cases, such as process machinery for the petrochemical industry, is this not the case. Although a number of feasibility studies have been made for the manufacture of heavy machinery and for a plant for the manufacture of capital equipment for chemical, petrochemical and food industries, these plants have not been built.

4. The local production rarely covers the total spectrum of needs and usually stops short of sizes or capacities not needed in large quantities. This is understandable because of the economies of production. The machine tool industry in Egypt is representative of this phenomenon. Lathes, for example, are manufactured, but no attempt is made to cover the whole range of simple lathes with different distances between centres. Furthermore, no attempt is made to cover the different types of lathes, e.g., turret lathes, copying lathes, automatic lathes or programmable and numerical controlled models, owing to the small numbers of lathes produced and sophisticated technologies involved.

5. Therefore, it is rarely the case that present production covers all quantitative needs and importation is totally restricted. Owing to continuously rising needs industry seems to have a backlog of orders, delivery times are mostly long and few items are available for immediate delivery. Because of this importation of goods that are also locally available and produced is sometimes allowed. There is a continuous struggle between industry and the consumer, with industry claiming the ability to deliver, demanding to know customers' requirements in advance and the customer (usually a State organization) pressing for importation. Examples are common in the transformer, switchgear, diesel engine,bus and truck manufacturing industries.

6. Extensions are planned in most industries with an extensive investment plan prepared within five-year periods. The latest plans are given in this study. The problem, however, of whether to embark on a centralized heavy machinery plant/capital equipment manufacture, or to extend the manufacturing facilities of existing plants, still seems unresolved. Without doubt there does exist a certain scepticism about the success of a concentrated capital equipment industry. Problems are the huge amount of capital needed, the limited market within the country, the source/s of technology and know-how, and finally the acceptance of the industry itself in taking over locally designed and manufactured capital equipment.

Egypt has got over the complex of foreign made products as such, and the local industry (because of price differences) is well accepted. However, when it comes to capital equipment and goods the resistance is strong. Decision makers will argue the danger of having the machinery made locally on the basis of up-to-date technologies, accuracy of production, capacity, reliability, etc.

7. A large percentage of industry is working according to international licences, but the last period of industrialization from 1960 up to around 1970 did not seriously encourage this, especially after the nationalization measures of the 1960s. Some plants deliveries from the East bloc countries, however, did include technologies within the context of delivery as a whole. The period of the 1960s also had its difficulties in the agreement for technology transfer and repayment of licence dues. Some licence agreements were also not renewed on the basis that a period of around five years must be sufficient to develop a local technology and maintain production. This unwritten guideline plus national pride has affected some licence agreements during the last period mentioned.

However, with the last investment law, Law No. 43 of 1973, technology transfer and licensing are encouraged and many well-known international names in industry are appearing again on the industrial scene.

8. Without doubt the country has accumulated considerable experience in many basic industries, and this is considered adequate. The main comment that may be made, however, is that there seems to be a widening gap[1/] and the local industry is not always able to bridge this gap. It may also be said that some smaller industries find it difficult to keep abreast (in knowledge alone) of what is going on in the corresponding industry in the industrially developed countries. Industry is continuously sending missions abroad, but there is a time lag in the process of:

- Awareness of change happening.
- Acceptance of need to change.
- Decision to change.
- Study for change.
- Formalities to obtain approvals for new equipment.

2.3 Iraq

2.3.1 Structure of the industry

The following eight major industries were identified from the yearbook of the Arab Federation for Engineering Industries as the major producers of capital goods in the public sector:

- The State Enterprise for Mechanical Industries which produces tractors, trailers, agricultural machines and tools, truck bodies and hand tools. This industry has been able to cover the entire domestic market and has the ability to export.

- The State Enterprise for Automotive Industries which produces small, medium, and heavy trucks as well as buses.

- The State Enterprise for Electrical Industries whose products include industrial electrical motors, oil transformers for power distribution (25 to 1,000 kVA), fans, water pumps, lamps, etc.

- The State Enterprise for Aluminium Semi-products which produces extruded profiles, wires, sheets, oxidized and non-oxidized sections, etc.

- The State Enterprise for Iron and Steel which produces, among other things, steel pipes. The country has a large direct reduction iron and steel plant at Khor al Zubair for producing rods and sections. The present state of the plant is unknown.

1/ The Industrial Technology Applications Project (ITAP) is contributing towards closing this gap by providing information, expertise, field tours and consulting.

- The State Enterprise for Batteries which produces dry cell batteries (An-Noor), car batteries for vehicles and tractors, and distilled water.

- The Industrial Complex at Dial a which consists of several modern industrial complexes. It is involved in existing and future industries relating to electric power generation, vehicle manufacturing, aluminium, iron and steel. Four factories are attached to this complex to produce electrical fans, electrical irons, spark plugs, electrical instruments.

- The State Enterprise for cables and wires which produces cables and wires.

In addition to the public sector establishments, the General Organization for Industrial Development participated with the private sector in establishing companies that produce the following:

- Bicycles
- Metal pipes
- Colour and black and white T.V. sets
- Radio and recorders
- Telephone sets
- Calculators
- Cassette tapes
- Electrical, gas, oil, kerosene heaters
- Oil and gas cookers
- Refrigerators and deep freeze units
- Air conditioners and desert coolers
- Oil and gas stoves.

The private sector has been active in the following industries:

- Aluminium products: window frames, sections, rods, etc.
- Oil and gas heaters
- Oil, gas, and electrical stoves
- Desert coolers
- Cables and wires
- Lighting bulbs
- Vehicle bodies
- Radiators and silencers.

In all cases, there is no information on the production capacity or actual output or on the sources of technology and local manufacturing.

2.3.2 Automotive equipment industry

The domestic motor industry so far has been limited to a number of assembly operations where vehicles are produced under licence from foreign companies such as Scania and Saviem for trucks and IKARUS for buses.

The trucks are imported CKD. Saviem supplies the low and medium range vehicles (from 2-10 ton GVW) and Scania supplies the high range vehicles (from 11.8-16.8 tons GVW). The local integration is about 10 per cent for trucks. The mini-buses, city and inter city buses as well as coaches are supplied by Ikarus. The production capacity and actual production in 1982 are shown below:

Table 11. Production capacity and actual production of trucks and buses in Iraq

Vehicle	Production capacity (unit)	Actual 1982 production (unit)
Saviem trucks (Salah El-Din)	2,250	900
Scania trucks	3,600	3,200
Ikarus buses (reem)	1,100	950

Source: Compiled by Joint ESCWA/UNIDO Industry Division.

Iraq has plans to produce cars and trucks on a large scale. The plans call for the production of a minimum of 120,000 cars and 25,000 trucks per annum, and the manufacture of components and parts. Investment is believed to be in the order of $US 5 billion. To this end a consulting contract was awarded in May 1981 to a consortium from the Federal Republic of Germany led by Weidle plan Consulting of Stuttgart. The original target date (1985) has been postponed owing to prevailing circumstances.

Tractors are assembled by the General Company for Mechanical Industries at Iskandariyah. The first tractor was assembled in 1971 under the name of Antar. In fact it was the Czechoslovakian tractor Zetor.

It has been reported that the local content has reached above 50 per cent of the cost of the tractor. The components which are manufactured locally in the plant include:

- Rear and front wheel ballast weight
- Fixed and swing draw bar
- Cooling system
- Pedals
- Front axle wheels
- Front mudguards and others.

The production capacity is 5,000 tractors per annum and can be increased to 7,000 tractors per annum. The majority of the tractors are the 70 hp model; the rest are the 80 hp model.

Car batteries are produced in Iraq. More than 24 types of batteries are produced. The designed capacity of the factory is reported to be about 480,000 units. In 1982 more than 400,000 batteries were produced.

- Fast turnover of skilled labour which results in high training costs and industrial inefficiency

- Shortage of specialized subcontractors and consulting firms in the field of engineering industries

- Shortage of locally produced parts and components as well as raw materials

- Lack of managerial and technical expertise.

2.4.2. Automotive equipment industry

In the automotive field, the Elba House Company, which was established in 1969 produces semi-trailers, vehicle bodies (refrigerator, tipping, tanker, buses and trailers (platform, tanker). Trailers and semi-trailers are also produced by the Send an Company. Both companies export between 70 per cent and 85 per cent of their total output of finished steel products.

Other activities include the production of vehicle batteries units based on local technology. Annual production amounts to more than 110,000 units, with 70 per cent local added value. Radiators are also produced by the Light Industries Company.

2.4.3. Construction equipment industry

The high level of activity in the construction industry has led to the establishment of a number of small industries which manufacture products needed by the construction industry. These include steel structures in which a dozen companies are engaged with production capacity ranging from 18,000 to 50,000 tons per annum. Another product is Concrete Mixers and Vibrators. They are manufactured with the assistance companies from the Federal Republic of Germany. Their engines and hydraulic gear are imported, and the local companies claim 52 per cent to 90 per cent local manufacturing.

Industrial overhead cranes and lifts are manufactured in Jordan by the Jordan Lift and Crane Manufacturing Co. (JOLIFT). The firm, which was established in 1973, is a private concern, 51 per cent nationally owned and 49 per cent owned by Thyssen of the Federal Republic of Germany which supplies the know-how. The equity capital of the company is 180,000 Jordanian dinars and the number of employees is 23, in addition to three engineers and 16 technicians. The total sales of the company in 1984 amounted to about JD 1 million, 65 per cent of which were sold at the local market and the rest exported. The major products of JOLIFT are:

- Lifts: designed capacity is 250 units per annum while actual production is 100 units, depending on market condition.

- Cranes: designed capacity is 40 units per annum. Actual capacity is 20 units. The local added value is about 50 per cent.

2.4.4 Electric power equipment industry

In spite of the impressive growth in the electricity sector during the 1970s and early 1980s which entailed the establishment of many generating plants and the expansion of the transmission and distribution network as well as the utilization of a huge amount of electrical material and equipment, the domestic industry failed to respond to the needs of the country. The reliance on imported material and equipment was almost total. This trend may well continue if one is to project the future from the following indicators.

(a) In 1980 a total of 115 industrial permits were granted. The corresponding investment came to about JD 18.7 million. The number of permits to establish an electrical power equipment industry did not exceed 4 per cent of the total, and in terms of investment it represented 2.6 per cent of industrial investments. The situation in 1981 and 1982 did not change in any appreciative manner.

(b) Among the 125 establishments which export part of their production to adjacent markets, only 9 establishments or 7.2 per cent were involved in manufacturing electric power equipment.

The existing production of electric power equipment is confined to cables and wires. Two companies are active in this field: Khalid Al-Kaisi Co. which produces insulated electric wire at a capacity of 15,000 kilometres per annum, and the National Company for the manufacture of cables and wires which has a production capacity of 4,000 tons per annum and is by far the largest of the two (capital: 4 million Jordanian dinars). In addition to cables and wires, other electrical goods produced in Jordan include refrigerators, washing machines, electric stoves and TV antennas.

As for the future, a number of projects have been evaluated in feasibility studies. They include:

(a) Manufacturing electric power cables up to a line voltage of 33 KV, as well as telephone cables. The production capacity would be 7,000 tons per annum. Capital investment would be around 25 million Jordanian dinars. Production is planned to start in 1987;

(b) Manufacturing electrical equipment needed in overhead lines and in the distribution stations. Capital investment would amount to 8 million Jordanian dinars;

(c) Manufacturing electricity meters;

(d) The manufacture of motors (0.5 to 2.5 hp) at a production capacity of 0.5 million motors per annum;

(e) The manufacture of electrical parts used in home electrical installations. Capital investment would range from 0.5 to 1.2 million Jordanian dinars;

(f) Manufacturing home water pumps and home lighting needs.

Radiators for cars, trucks and tractors are produced by the following companies:

- Baghdad Company for Manufacturing Radiators.
- Iraqi Radiators Manufacturing Company.
- Rafidain Company for Production of Radiators and Silencers.
- National Factory for Manufacturing Radiators.

It has been reported that Iraq manufactures certain types of tyres. The production capacity and other relevant information are not available.

2.3.3 Electric power equipment industry

(a) Cables and wires have been produced in Iraq since 1978. Over 21,000 tons of cables and wires are produced per following types:

- Overhead wires made of aluminium and reinforced with steel for electricity networks.

- Overhead wires made of copper for the same application.

- Low tension armoured and non-armoured aluminium and copper cables for underground applications.

- Low tension copper cables for underground and overhead applications.

- Bare copper wires for use in making cables and various winding wires.

- Insulated wires for use in the manufacture of motors, transformers, coils, etc.

- Telephone cables: paper-insulated and cotton insulated.

(b) Transformers for the distribution network have been manufactured in Iraq since 1967. Recent production amounted to 2,400 units whereas the plant capacity is 2,800 units per annum. In 1983, production started for the 100-1000 kVA 33 kV transformers and the 5-63 MVA 132 kV transformers with plant capacities of 3,400 and 3,000 MVA per annum respectively. Actual production figures are not available although it is reported that all of the output will be used in the domestic market.

(c) Measuring instruments have been manufactured since 1978. Current production amounts to 240,000 units of the single phase type and 19,000 units of the three-phase type. The plants capacities are 250,000 and 20,000 units per annum respectively.

2.4 Jordan

2.4.1 Structure of the industry

With the exception of a few large companies, the industry in Jordan is dominated by a large number of small-size establishments. The majority of

these establishments are concentrated in or around the Amman-Zarqa region because of many factors including proximity to the main markets, access to major highways, availability of labour and infrastructural facilities. The large mining and extractive industries such as phosphates and potash are exceptions to the rule and are located near their sources of raw material. Again, with the exception of the extraction projects, the industry relies heavily on imported material and technology. The limited size of the domestic market and the country's modest resource base as well as the rapid turnover of skilled labour constitute major obstacles to industrial development in Jordan.

The capital goods and engineering industry encompass of metal and non-metal industries as well as equipment manufacturing. Non-metal goods are produced by several hundred companies and include ceramics, glass, marble, cement and prefabricated buildings. Metal goods currently produced include structural steel, steel pipes, welding electrodes, saws, locks, wires and cables and aluminium sections and truck bodies. New products such as pumps, hand tools, nuts, bolts and screws will be manufactured in the near future.

A new development in the metal products industry has been the trend to manufacture not only final products but also intermediates such as cast iron foundry products, non-ferrous foundry products, die cast products and tools and dies. This would increase the local added value and strengthen the control over the supply of important industrial inputs. However, the extent to which this upstream development can be implemented is constrained by the shortage of local raw materials and the high cost of energy.

Other capital goods production includes non-electrical and electrical machinery, apparatus, appliances and supplies of which a substantial part (40 per cent to 90 per cent) are exported. The major products, and corresponding foreign technology sources are given below:

- Gas cookers (Canadian)
- Washing machines (Canadian)
- Electric water heaters (Canadian)
- Refrigerators (British)
- Electrical fittings (United Kingdom)
- Variety of household appliances (Zanussi of Italy)
- Solar energy systems (Solar King of United States)
- Fluorescent lamps (British, French)
- Aladin stoves (Aladin Industries of Britain)
- Deep freeze units (Italian)
- Dry batteries (local and Arab)
- Radiators for central heating systems (Irish, Danish, Swiss)
- Boilers for central heating systems (Federal Republic of Germany)
- Immersion heaters and weighing machines (n.a.)
- Lifts and Cranes (Thyssen of Federal Republic of Germany)

The constraints impeding the development of the capital goods and engineering industries include:

- Small size of the market

The feasibility studies identified a number of factors which make domestic manufacturing of most electrical products uneconomical. These factors are:

- The domestic market is small and does not support viable production capacity.

- Exports to adjacent markets are not secured.

- Exports to Arab countries are not protected from unjust competition by multinational companies.

- There is a lack of co-ordination among Arab countries with the result that similar projects are implemented in those countries. This prevents the establishment of large production capacities which could compete with the multinationals.

- There is a lack of standardized products which again limits the market for these products as well as the capacities for producing them.

- There is a lack of interaction between the industry and the centres of research and development. This paves the way for foreign companies to step in and influence actions which will serve their own interests.

- There is difficulty in obtaining reliable data from other countries about the demand for the various products.

2.5 Kuwait

2.5.1 Structure of the industry

The capital goods industry is largely undeveloped. The small size of the domestic market places a constraint on establishing such industry. Nevertheless the present activities are described below.

2.5.2 Automotive equipment industry

Although Kuwait has no vehicle assembly, it does have considerable investment in companies in the automotive sector. Kuwait bought 10 per cent of Volkswagen Brazil in June 1980, and is thought to have followed that purchase with the acquisition of around 0.6 per cent of VAG, Federal Republic of Germany. It has also several other holdings in German industrial companies, and is among the largest holders of Daimler Benz shares (14 per cent). It has been reported recently that the country is negotiating to increase its shares of Daimler Benz by another 10 per cent, and is investigating the possibility of producing Magirus Deutz trucks at a production capacity of 1,000 trucks per annum.

Other activities include the production of tippers (3-18 m^3), tipping trailers and semi-trailers (18-30 m^3), tanker trailers and semi-trailers (4,500-54,000 litres) and garbage trucks. Over 3,000 units are produced annually by the Alam Steel Industries Company. The company, which is a private enterprise, was established in 1962 and presently employs over 325 persons. Depending on the product, the local added value ranges from 29 per cent to 75 per cent and the export potential ranges from 50 per cent to 95 per cent. It is not clear whether the company relies on its own expertise completely or acquires technical assistance from foreign companies.

Another company, the Babiteen Company for the manufacture of vehicles' bodies, is engaged in producing bodies for tippers, trucks, tankers, buses and trailers. The company produces about 3,200 units per annum at a local added value of 65 per cent and can export up to 80 per cent of its production. Al Babiteen Company was established in 1978 as a private sector enterprise. It employs about 163 persons, and relies for technical know-how on Kuwait and American sources. Vehicle bodies are also produced by the following companies:

Table 12. Companies producing vehicle bodies in Kuwait

Company	Sector	Number of employees	Annual production (units)	Potential exports (units)	Local added value	Sources of know-how
1. Al Sani and Helwani	Private	87	600	90%	74%	German/ American
2. Al Masna Al Arabia	Private	169	650	as requested	35-40%	German/ Kuwait
3. The Arab Co. for the manufacture of transport vehicles	Private	178	100	80%	70%	French
4. The Kuwaiti Co. for the manufacture vehicle bodies	Private	223	2900	n.a.	n.a.	n.a.

Source: Compiled by joint ESCWA/UNIDO Industry Division.

In addition to the above, two companies produce radiators for small and large cars as well as tractors. They are the Kuwaiti Radiator Factory and the Shaihan Radiator Factory. The production capacity is 19,000 units and the local added value ranges from 30 to 40 per cent. The companies rely completely on Kuwaiti personnel.

2.5.3 Electric power equipment industry

(a) Cables: Electric and telephone cables are produced by the Gulf Company for the Manufacture of Cables and Electrical Industries. The company, a private enterprise, was established in 1977, employs over 145 persons and relies on domestic know-how. It produces about 20,000 tons of 12/20 KV cables per annum. The local added value is reported to be 60 to 100 per cent.

(b) Distribution Panels: Several companies are engaged in this activity and currently produce over 24,000 units per annum. They are:

Table 13. Companies manufacturing distribution panels in Kuwait

Company	Sector	Number of employees	Annual production (units)	Potential exports (units)	Local added value	Sources of technology
Distribution Panel Mfg.	Private	77	3 million K.D	40%	35-40%	Foreign
Al-Amir Electrical Co.	Private	13	5 million	50%	35%	Local
Electrical Contracting Co.	Private	129	over 1 million units	30%	55%	Danish
Al-Malhab Contreacting Co. requested 40%	Local	Private		as 21	500	units
Dakheel Al-Jassar Co.	Private	146	1300 units	as requested	70%	British

Source: Compiled by Joint ESCWA/UNIDO Industry Division.

In addition to the above, many companies manufacture air conditioning units with the help of American and British companies, water coolers (Indian assistance), television antennas (Federal Republic of Germany know-how) and other consumer goods.

2.5.4 Manufacture of spare parts

Recognizing the vulnerability of the petroleum-based industry to foreign dependence, particularly in the domain of repair and maintenance, the Government of Kuwait encouraged the private sector to enter into this business, first relying on foreign technical assistance, and eventually creating a technical capacity in the region. The Kuwait Industrial Refinery

Maintenance and Engineering Company (KREMENCO) is an exemplary illustration of such a developing activity. KREMENCO was established in 1969, and is owned by private sector shareholders (89 per cent national and 11 per cent foreign). Its activities centered on: (a) design and fabrication of steel structures and pipeworks; (b) design, manufacture and assemblage of pressure vessels, heat exchangers and condensers; (c) nondestructive testing of equipment; (d) chemical cleaning, painting and sandblasting; (e) insulation and lining of tanks and pipes; and (f) maintenance and repair of refinery and power station equipment.

The company has a labour force (skilled and unskilled) of 1,300 employees, including 18 engineers, and has executed projects with a value of KD 25 million. It has rendered services to different industrial customers in the Gulf region (Saudi Arabia, Bahrain, Qatar and Kuwait).

Four main divisions make up the KREMENCO organization, namely manufacturing, maintenance, engineering and design. The manufacturing division oversees activities that are related to fabrication of structural steel and pipe, construction of heat exchangers, chemical, sand and hydroblasting and painting of equipment, erection of vessels and pipes, and supply of shutdown services including labour. Present annual capacity of structural steel work is about 10,000 tons. The division also provides a full service for retubing heat exchangers, vessels and other tubular equipment. The mechanical and fabrication equipment include machines for pipe cutting, threading, and bending, cement and brick grinding, plate bending, rolling and shearing, tube sheet drilling and welding machines. The provision and manufacture of high pressure and temperature vessels, reactors and heat exchangers often made from high grade alloy steels are secured via a long standing agreement with Stahl-und Apparatebau Hans Leffer of Saarbrucken - Kudweiler, Federal Republic of Germany. The German company provides support in terms of technical assistance such as feasibility studies, detailed design, engineering and procurement, when such special equipment is included in the manufacturing contract of KREMENCO.

The maintenance division undertakes activities that include scheduling and planning, preventive maintenance, analysis of spare parts and material requirements and technical supervision. In this respect, KREMENCO uses the technical and managerial skills of its partners in the United Kingdom to spearhead the project planning, operation and management. The maintenance and repair services rendered to local and regional customers embrace mechanical, electrical and instrument maintenance relevant to refinery units, gas plants, and power stations. The engineering and design division handles engineering consultancies including feasibility studies, design, detailed engineering, engineering procurement, erection of sophisticated equipment, supervision of specialized welding, and planning and scheduling for complete projects. Supervision of final engineering production and erection are provided by British and other European expatriate engineers and technicians within KREMENCO workshops and in the field.

The workshops of KREMENCO are also well equipped with non-destructive testing instruments, such as ultrasonic and gamma X-ray, stress relieving units, and soaking vats for chemical cleaning and hydroblasting of bundles.

Generally, KREMENCO is considered a domestic asset in Kuwait, which complements and provides a backup to the maintenance expertise and capabilities established in Kuwait National Petroleum Company (KNPC) refineries. They undertake routine maintenance activities and repair services in addition to their heavy involvement at peak load of scheduled shutdown periods.

2.6 Morocco

2.6.1 Development of the industry

Morocco has a limited capital goods manufacturing industry. It provides approximately 10 per cent of the needs of the country in capital goods equipment, the rest is imported.

The potential market has a value of approximately 8 billion Moroccan dirhams. The import of capital goods constitutes a heavy burden on the total trade balance. Capital goods form about 45 per cent of all imports of the industrial sector. There is virtually no export of capital goods produced in the country.

The laws concerning industrial investment actually encourage importation because capital goods equipment can be brought into the country free of duty. Hence, there is no incentive in most cases for foreign or local entrepreneurs to manufacture these goods in the country.

In the five year development plan for 1981-1985 the importance of the capital goods sector for the country's economic development was emphasized and the strategy and objectives for its development were formulated as follows:

- "To follow a policy of import-substitution, directing it more towards the production of goods fulfilling basic needs or strategic objectives and towards the production of intermediate consumer goods and capital goods;

- "Stimulation of the export of industrial products;

- "The mastering of the technology is the most important factor in this sector, and the development of its activities can only be achieved if Morocco can implement a policy that promotes the transfer of technology".

The plan adds further that national technologies should be developed in areas where sectoral plans already exist, as is the case of sugar factories, cement and fertilizer plants. Its objective is to maximize the local content of parts that are used in the manufacture of capital goods.

2.6.2 Structure of the industry

The capital goods sector comprised in 1980 approximately 100 enterprises with a total of 4,000 employees. In addition there were 66

enterprises with 6,380 employees involved in the production of transport equipment (cars, trucks, buses, motorcycles, railway rolling stock, shipbuilding).

A list of capital goods equipment produced includes the following:

- Agricultural equipment: ploughs, discs, harrows, trailers, tank trailers;

- Diesel engines;

- Bakery equipment;

- Material handling equipment: conveyors, rollers;

- Construction equipment: cranes, dumpers, cement mixers;

- Simple machine tools: bending machines, cutters, piercers;

- Pumps of various types;

- Commercial vehicles: trucks of various types, utility vehicles; bodywork, ships;

- Transformers, circuit breakers;

- Electric cables;

- Electric motors;

- Small electricity generators;

- Railway freight cars;

- Parts for equipment for mineral extraction and processing: stone crushers, grinders.

The production of machines and capital equipment can be divided into four subsectors as follows:

Subsector 1: metalwork machines

These are tools and machines, generally of a conventional type, such as lathes, drills, grinders or boring machines. In Morocco, hardly any numerical controlled equipment can be found among these.

Subsector 2: metal cutting and bending machines

This comprises shears, cutlers, saws, presses and folding machines. Also these are mostly of a conventional type, with few automated ones.

Subsector 3: special purpose machines

These include specialized machines and equipment for foundries or electrical equipment plants. The plants for the production of cables and transformers have recently been established with modern equipment.

Subsector 4: general purpose equipment

This encompasses inter alia installations for thermal treatment and motors for cranes.

Regarding the technical management, most of the enterprises have studies departments. However, these organizations still lack qualified engineers, technicians, designers etc. and therefore their activities are limited indepth. In most cases assistance is needed from the (foreign) parent company.

Only the following companies provided detailed information:

(a) The General Electrical Company (GEC - Maroc): Industrial electric equipment

This factory was established in 1947, and is managed by the French parent company which holds two thirds of its capital and provides most of the technical, commercial and financial management staff.

It produces electrical cables (8,000 tons per annum, power transformers and electric batteries (150,000/yr), under licence from the foreign company, only for the domestic market.

The company stated that in 1983 it had the following number of employees, divided by occupation and educational background:

Occupation	Local	Foreign
Senior managers	2	2
Administrators	20	1
Engineers	41	18
Others	560	-
Education		
Vocational degree	100	-
Bachelor's degree	14	7
Master's degree	2	2
Doctorate degree	-	-

(b) Berliet - Maroc: Assembly of trucks and buses

The company, which was established 1959, supplies more than 50 per cent of the local market for trucks and buses. It is a joint venture with the French company Renault (RVI) and the trucks assembled are adapted to suit local conditions. More than 80 per cent of the total value of the trucks is

imported (engine, gear-box, rear-axle, cabin, chassis, steering). On the other hand, more than 50 per cent of the total value of buses is of locally manufactured origin.

At present the factory faces a high degree of under-utilization, for its truck assembly, since it operates at only 15 per cent of its designed capacity owing to the depressed market. Its bus-assembly programme also operates at less than 50 per cent of its capacity.

The breakdown of its employees were given by the company as follows:

	Local	Foreign
Senior managers	7	1
Administrators	30	-
Electrical engineers	1	-
Mechanical engineers	2	-
Production engineers	1	-
Economists	2	-
Others	281	-

As for their educational background, the company reported the following:

	Local	Foreign
Vocational degree	43	10
Bachelor's degree	10	2
Master's degree	4	3
Doctorate degree	1	1

(c) SCIF: Industrial boiler making

This company produces there different types of products: railway wagons and coaches (freight and passengers), gas bottles and boilers.

This establishment, in existence for more than 30 years, is a diversified and basic industry, of great importance for Morocco. It was nationalized in 1973 and the former (French) partner now has a minority interest in the company. The remaining foreign staff is gradually being replaced by nationals. An agreement covering technical and commercial assistance has been concluded with this partner. The agreement provides for studies and manufacturing techniques, training of personnel, and the participation in studies for new activities to be undertaken by the establishment.

A number of agreements have also been concluded with East and West European companies for the production of conveyors, steel bridges for railways and silos for sugar factories.

(d) CMIM: Construction materials

This well-equipped plant is owned by a group consisting of a semi-public organization, private Moroccan and other (Gulf) Arab interests.

It produces various metal structural products, but owing to the recent recession it produces at only 40 per cent of its designed capacity. No other information is available.

(e) The Mechanical and Electrical Industries Company (SIMEF)

This company was converted in 1972 from an armaments plant into the present motor-producing factory.

It produces, under different licences, diesel and electrical motors for irrigation pumps, and industrial use. The following production capacities were reported by the company:

Capacity	Designed	Actual
Electrical motors	12,000	6,000
50 cc motor	60,000	34,000
Diesel engines	3,000	2,500

The licences with (four) European manufacturers provide for the assembly of the motors based upon parts received from the licenser. All the companies provide technical assistance and receive a royalty fee under these agreements.

Of the total staff of 300, about 20 per cent are engineers and technicians. They manage to operate the three production lines to a satisfactory extent.

Adaptations of the benzine motor to local circumstances have already taken place, and several proposals for new machinery to be manufactured are under study. The Company also has a project for the establishment of a foundry to produce parts for all its products. It collaborated closely with the ODI for the study phase, but design and construction were carried out by local engineering offices.

The Company has a total of approximately 100 employees, divided as follows:

	Local	Foreign
Electrical engineers	7	2
Mechanical engineers	9	2
Civil engineers	9	1
Economists	1	-
Technical specialists in project studies	36	4
Technical specialists in execution of projects	20	-

2.7 Saudi Arabia

The production of capital goods in the Kingdom is limited, the main areas of production are assembling vehicles, manufacturing steel structures and aluminium products for construction purposes and manufacturing electrical products. These activities are described below.

2.7.1 Automotive equipment industry

The National Automobile Industry (NAI) in Jeddah assembles Mercedes trucks. The plant capacity is about 6,500 units per annum, in one shift, or 10,000 units per annum in two shifts. Major components such as engines and gear boxes are most likely manufactured on the site. The trucks that are being assembled are:

- Mercedes 1924 range, 19 tons GVW: 60 per cent of production
- Mercedes 2524 range, 26 tons GVW: 30 per cent of production
- Mercedes 911 range, 9 tons GVW
- Mercedes 1113 range, 11 tons GVW.

The total investment of NAI amounts to 90 million Saudi Arabian riyals. The company is jointly owned by E.A. Jaffali and Brothers (74 per cent) and Daimler Benz (26 per cent).

Japanese Hino trucks are also assembled in the country by Jamjoom Hino Motors. As with the Daimler Benz project the Saudi Arabian partner, Jamjoom Brothers, has majority interest (67 per cent) and the remainder is shared between Hino and Toyo Menka Kaisha, a Japanese trading house. In the initial stages, Jamjoom-Hino were producing 1,200 trucks per annum.

Another project has been envisaged by Jaffali and Brothers and Massey-Ferguson to assemble tractors. The factory would be located in Jeddah and have a capacity of 1,500 to 2,000 tractors per annum. The project would use components manufactured by Massey-Ferguson in the United Kingdom which would take 20 per cent of the initial capital of the new company.

Other activities in the country include the manufacture of vehicle bodies and batteries. The main companies in this field as listed in table 14.

2.7.2 Electric power equipment industry

(a) Cables and wires

The Saudi Cables Co. manufactures medium and low power cables. The specifications are PLEA (American), ASTM (American), BSS (British), VDE (German) and IEC (International). The company relies on American and Arab sources of technology. It produces 24,000 tons of aluminium and copper cables and can export 6,000 tons per annum. Local manufacture content ranges from 20 per cent to 25 per cent. The Company was established in 1974 and is located in Jeddah. It employs 267 persons.

(b) Transformers

The production of transformers (25-2500 KVA) started in 1984 and is currently producing about 8,400 units per annum.

(c) Poles

The Ameeka factory, which was established in 1979 and employs 96 people, manufactures poles for high, medium and low tension lines in

Table 14. Companies manufacturing automotive parts in Saudi Arabia

Name of company	Source of technology	Sector	Establishment date	Number of workers	Product	Annual production capacity (unit)
Metal Fabrication Co.	Local	Private	1978	87	Trailers	200
					Tippers	150
Saudi Co. for Vehicles	American 100 %	Private	1978	94	Bus	660
Arab Metal Industries Co.	Federal Republic of Germany 25%	Private	1975	260	Tippers	1,500
Al-Homaidan Factories	Local	Private	1977	110	Trailers	60
					Tippers	420
					Tankers	160
Krosi Factory	Local 60%	Private	1970	49	Tippers	260
					Tankers	260
					Trailers	260
Saudi Bus Factory	Local	Private	1974	42	Bus	200
Al-Kaseem Factory	Local	Private	1975	24	Trailers & Tankers	147
Al-Mubarak Trailer Co.	Local	Private	1976	36	Trailers	40
					Tankers	24
Al-Mutlak Vehicle Body Co.	Local	Private	1977	69	Tippers	210
					Tankers	48
					Trailers	30
National Industries Co.	American 20%	Private	1973	32	Batteries	45,000
Al-Salameh Radiator Co.	Local 100%	Private	1977	54	Batteries	3,600
Al-Foozan Radiator Co.	Local	Private	1972	22	Batteries	10,000
Al-Nahda Radiator Co.	Local	Private	1969	33	Batteries	72,000

Source: Compiled by Joint ESCWA/UNIDO Industry Division.

accordance with international specifications. The factory produces 10,000 iron poles, of which 6,000 poles are galvanized. The company relies on local technology.

Electricity poles and telephone poles are also produced by the Saudi Company for Heavy and Light Steel Works (60,000 units per annum) and the Al-Anwar factory (27,000 units per annum).

(d) Distribution panels

Many companies produce these panels. Among them there are the Jamjoom factory which relies on American technology, Saudi Westinghouse Co. which relies on American technology, East and West Co. which initially relied on British technology and then shifted to American technology. The Babiteen Company produces at present about 420 panels per annum and 10,000 meter boxes per annum.

In addition, many companies are engaged in manufacturing industrial products and consumer goods such as:

- Small transformers, with French assistance, 50,000 unit/annum.
- Battery chargers
- Soldering irons
- Fluorescent lamps, with Swedish assistance, 72,000 units/annum
- Water cooler, American and local technology
- Deep freeze units, American and local technology
- Circuit breakers, British technology
- Dry cell batteries, Finnish technology, 13 million unit/annum
- Room air conditioners, local and American technology
- Central air conditioners, American technology
- Desert coolers, American technology
- Electric heaters
- Electric stoves
- Electric water heaters
- Electricity meters

2.8 Syrian Arab Republic

2.8.1 Development and structure of the industry

Industrial development in the Syrian Arab Republic has been growing steadily since the early 1970s as a result of the high priority given to the industrial sector in the three development plans from 1970 to 1985. The allocations to the manufacturing industry sector in the plans are shown in table 15.

The growth of the industrial sector required certain expertise and know-how which were not readily available at the various bodies in charge of planning, identification, formulation, implementation and operation of industrial projects. It was therefore natural to resort to foreign advisory services, expertise and know-how to ensure proper implementation of the projects as envisaged by the development plans.

Although significant progress has been achieved by the manufacturing industry since the first five-year plan, the development of capital goods and heavy engineering industries has not kept pace with it. The main thrust for the development of these industries was given under the Fourth Five-Year Plan (1976-1980) according to which substantial allocations were made to such projects as tractors and agricultural implements production, electric cables, electric motors, metallic pipes, metallic construction and aluminium profiles.

Table 15. Allocations to the Manufacturing Industry Sector in the Syrian Arab Republic

Industrial branch	Third plan 1970-1975 Allocations (Million of Syrian pounds)	Fourth plan 1975-1980 Allocations (Million of Syrian pound)	Fifth plan 1981-1985 Allocations (Million of) Syrian pound) a*	b*
Vocational training	4.4	71.0	141.7	
Industrial testing and research	12.6	10.1	25.6	
Management development	8.1	3.0	13.6	
Textiles	204.4	1,228.0	890.7	
Engineering	115.1	673.3	177.4	
Chemical	207.0	3,402.4	748.5	
Food processing	70.4	163.5	79.8	
Sugar	10.1	617.4	244.8	
Portland cement and building materials	150.0	2,570.6	951.2	4050.2
Tractors and agricultural implements	97.3	150.0	34.5	
Flour mills and bakeries	66.0	361.0	1,817.3	
Tobacco[c/]	37.0	136.0	79.7	
Oil refining	-	1,429.2	1,290.0	
			6,794.8	4,050.2
Total	982.4	9,386.3	a/ + b/ 10,845.0	

Source: Compiled by Joint ESCWA/UNIDO Industry Division.

a/ Allocations corresponding to the basic stage (for existing establishment and projects being executed).

b/ Lump sum allocations, to be distributed to new projects.

c/ Not under the Ministry of Industry.

The metallic pipes factory was established by the DEMAG-MEAR Company of the Federal Republic of Germany on a turnkey basis. Production started in 1978. The capacity of the factory is 20,000 tons per annum of pipes.

Metallic construction and process equipment manufacturing is undertaken by the General Construction Company for metallic and mechanical industries which is a public sector enterprise. Its products include steam boilers produced under a foreign licence, tanks, vessels and metallic constructions, solar energy equipment, greenhouses, coach work for buses and microbuses.

Aluminium profiles and frames manufacturing is the responsibility of the Aluminium Profiles Company in Lattakia. The Company was established in 1974 by two French Companies (SECIM and JOUFFRIEAU) on a turnkey basis except for part of the civil works, namely the foundations and the administration building. The project was completed in 1977 and production commenced in 1978. Production capacity is 4,000 tons per annum.

Backward linkage integration in steel bar production was introduced in the Fourth Five-Year Plan though the erection of a scrap foundry plant which produces 120,000 tons of billets per annum used in the steel bar rolling mill (production capacity is 120,000 tons per annum). However, the predominant orientation of the industry is towards light consumer goods. The capital goods industries do not account for more than 6 per cent of the GNP which is one quarter to one half the proportion recorded in many other Arab countries.

The light consumer goods include the following:

- Home refrigerators production: The private sector 20,000-22,000 units per annum using local and foreign technologies. The public sector produces 120,000 units per annum, using Austrian technology. The company exports 30,000 units per annum and employs over 1,300 persons; local added value is 70 per cent.

- Deep freeze units with local and foreign technology.

- Industrial refrigerators with Italian technology.

- Washing machines produced with technological assistance from the Federal Republic of Germany, the United Kingdom, the United States and Belgium. Annual production exceeds 50,00 units, local added value ranges from 60 per cent to 75 per cent and the machines are mainly produced by the private sector.

- Gas heaters are produced by the private sector with technology from Japan, the German Democratic Republic and Czechoslovakia.

- Gas stoves and produced by both the private and public sectors with Italian and local technology.

- Air conditioning units are produced by the private sector only. More than 15 producers of air conditioners, using French, American and other technologies, are currently engaged in this activity in workshop - type production. Current production does not satisfy the present local demand.

The public sector Syrian Arab Electronics Company in Damascus which was established in 1965 and currently employs over 1,220 persons manufactures the following products.

- Black and white picture tubes for Television units used as spare parts with an annual production of 2,000.

- Colour TV sets with Federal Republic of Germany technology (Telefunken): annual production is over 50,000 sets. Export potential exceeds 10,000 sets, local added value is 25 per cent.

- Telephone sets with Shiakiltael technology. Production is over 50,000 sets per annum. Local content added value is 45 per cent.

- Small exchanges with Swedish technology (L.M. Ericsson): production totals 20,000 units with local added value of about 45 per cent.

2.8.2 Automotive industry

The Al-Furat Tractor Company in Aleppo is the first joint-venture enterprise established in the Syrian Arab Republic. The Syrian share is 75 per cent and the Spanish (Motor Iberia) share is 25 per cent. The Company was established in 1974 with a capital of 16 million Syrian pounds. The Company's capital was raised to 32 million pounds in 1977 and to 150 million pounds in 1982. The objectives of the Company were stated as follows:-

- Manufacture of agricultural and industrial tractors and engines as well as agricultural machinery and implements;

- Manufacture of machinery, equipment and materials related to road transport.

The Company started its activities with the assembly of agricultural tractors. Under the Fourth Five-Year Plan, 1976-1980, the company shifted from a pure assembly operation to the manufacture of tractor components. Thus the percentage of locally manufactured components increased from about 8 per cent during the period 1975-1980 to 55 per cent at the beginning of 1985. The growth of tractor production is shown in table 16 and the production output was expected to reach 6,000 tractors per annum, of 70 HP rating.

The Company's plant is an integrated one, and consists of the following facilities.

- The foundry shop: the production capacity of this shop is 6,000 tons per annum, for 3,000 tractors and 5,000 engines on a two-shift basis. The foundry shop at present also supplies about 1,000 to 1,500 tons per annum of spare parts to public sector enterprises.

- The forging shop: this shop has a production capacity of 1,500 tons/year of forged steel components needed for 3,000 tractors.

Table 16. Growth of tractor production in the Syrian Arab Republic

Year	Value of production (Million of Syrian pounds)	Actual production (units)	Per cent locally manufactured components
1974	12	817	
1975	101	4,079	8
1976	114	4,183	8
1977	74	2,661	8
1978	50	1,830	8
1979	54	1,820	8
1980	102	2,601	8
1981	149	3,200	17
1982	172	3,300	19
1983	201	3,928	38
1984	201	3,902	53

Source: Compiled by Joint ESCWA/UNIDO Industry Division.

- The machine shop: it consists of three lines for the production of:
  - Axes
  - Gears
  - Finished items (coming originally from the foundry shop).

It also includes;

- The thermal treatment section
- The quality control section
- The measurements laboratory
- The physico-chemical laboratory.

This shop has a capacity to produce items needed for 3,000 tractors/year, with possibility of increase.

- The press shop: this shop supplies all pressed sheet metal pieces required for the production of 3,000 tractors/year, with possibility of increase.

- The assembly shop: in this shop the assembly of all tractor components, both imported and locally manufactured, takes place. The designed capacity of this shop is 20 tractors/day, on a single shift basis. At present, the shop is being operated at the rate of 15 tractors/day for one shift.

The assembly shop includes, in addition to the two main assembly lines, the following auxiliary workshops:

- Metal working and welding workshop
- Machinery and equipment maintenance workshop
- Service lines (fuel, water, air) maintenance workshop
- Moulds workshop
- Press workshop
- Tools workshop
- Electrical workshop
- Burners workshop
- Carpentry workshop
- Upholstery workshop.

All these workshops are fully equipped and are manned by trained workers.

- The agricultural implements production shop: implementation of this shop, which was envisaged to have a production capacity of 15,000 implements/year, has been suspended. Work in this field was for some time restricted to the assembly of some CKD imported agricultural implements, like cultivators, ploughs and disks, in a special assembly shop.

The Company is now planning to embark on the production of those implements which are essential to the agricultural tractors, like disk ploughs, three bladed ploughs and smoothening disks in the first stage and cultivators in the next stage.

- The technical office: in this office all documentation related to machinery and equipment installed in the various Company shops are available, in addition to documentation dealing with their methods of operation, production and maintenance.,

This office is now being expanded and developed in order to undertake engineering design and development of the various items produced by the Company. In this context, use will be made of the services of a limited number of experts specialized in production engineering to undertake training of local engineers and technicians.

Other activities in the automatic field include the manufacture of vehicle bodies, tankers, heavy trailers, and tippers. It has been reported that the tyre plant supplies the required tyres for the tractors. In addition a study was conducted by the Syrian Government to set up car assembly operations. Offers were submitted by Peugeot, Renault, Volkswagen and others. No progress has been reported in that respect. Moreover, it has been reported that a study was undertaken for setting up an assembly plant producing 4,000 Magirus Deutz trucks per annum.

2.8.3 Electric Power Equipment Industry

(a) Cables

The electric cables industry comprises two public sector enterprises, one in Damascus and the other in Aleppo.

The General Cables Company in Damascus was first established in the early 1960s. In 1965, it was nationalized. Its production capacity was 250 tons per annum. Since then the capacity was substantially increased. It became 500 tons per annum in 1970 and 960 tons per annum in 1973. In 1980, the Company was employing 771 persons and producing 5,000 tons of copper cables and 500 tons of aluminium cables per annum, all for the domestic market. The local added value was 80 per cent. After the latest expansion, the Company was able to produce a wide range of products such as:

(i) Copper cables: power cables for low voltage, up to 1 KV, both bare and insulated;

Twin cables;

Telephone cables;

TV cables, both flat and coaxial.

(ii) Aluminium cables: power cables;

Steel reinforced cables.

The machinery and equipment needed for the expansions were supplied, according to contracts concluded in the last quarter of 1974, by the following sources:

- Technoimpex of Hungary for copper drawing machines;
- Covema of Italy for insulating machines;
- Lesmo of Italy for mending and reinforcing machines;
- Jouffriean of France for the execution of the metallic construction shop to house the new machinery.

The implementation of the Cable Factory in Aleppo was started in 1975 and continued through the Fourth Five-Year Plan (1976-1980). The production capacity of the factory amounts to 8,600 tons per annum, distributed as follows:

1. Copper cables for low and medium voltages with a capacity of 3,000 tons per annum;

2. Aluminium cables: power lines, steel reinforced and insulated cables with a capacity of 5,000 tons per annum;

3. Copper oil wire with a capacity of 600 tons per annum.

It was decided to execute this project locally, and contracts were concluded with foreign suppliers of machinery and equipment. These were the same firms that supplied machinery and equipment for the expansion of the Damascus Cables Company. The implementation of the project was originally envisaged to be completed in 1978, but it was only completed in 1981 because of many reasons, mainly poor performance of the domestic contractor for civil engineering and construction work, lack of skilled technical personnel at the plant site and delays in the completion of operations and studies entrusted to a local design and execution establishment.

(b) Electricity motors

Single-phase motors are manufactured at the rate of 100,000 units per annum, although the plant capacity is twice that figure. Improvements have been instituted in the factory to manufacture three-phase motors and to raise the production output to cover the entire national market.

(c) Cement poles

These are manufactured in two factories, one in Deir El-Zour and the other in Homs. The annual production of both factories is about 7,500 units. The poles, whose height range from 9 to 12 motors, are used for low and medium line voltages.

(d) Steel towers

The General Electricity Establishment relies on both the public sector and private sector companies to manufacture these towers which are used for low and medium line voltages of about 20 KV, and sometimes up to 66 KV. For high line voltages, 230 and 400 KV, the General Electricity Establishment imports the towers from abroad because manufacturing these towers locally would not be economical. To be viable, a factory must manufacture 20,000 tons per annum, which exceeds the needs of the country.

(e) Distribution panels

Low voltage panels are produced in various public and private workshops. However, no switch-gear equipment is produced because such industry requires a much larger market than the Syrian market.

(f) Insulators

Several studies were conducted to determine the viability of locally manufacturing these products, both the porcelain and glass types. Invariably it was found that the size of the market did not justify the establishment of this industry, and thus Syria imports its needs from foreign sources.

(g) Transformers

The Ministry of Electricity evaluated the feasibility of manufacturing distribution transformers (25-1,000 KVA) for 0.4 to 20 KV voltages. The study indicated that such industry would not be viable unless feeding industries were also established so that transformer manufacturing would become totally integrated. Since this exceeds the capabilities of any one Arab country such as Syria, it was decided to establish instead a transformer repair workshop with a high voltage laboratory.

Small transformers for industrial and consumer application are manufactured with assistance from Austrian, Italian, and Federal Republic of Germany companies.

(h) Electric motors

Large motors are not manufactured in the country because of the limited market. However, small fractional horsepower motors (1/8 to 1/2 horsepower) are manufactured by the General Electrical Motors Company which was established in 1974 in Latakia. The Company gets technological assistance from Belgium. Production amounts to 100,000 units per annum. The entire production is used by other industries manufacturing consumer durables including washing machines, fans and water pumps. The local added value is reported to be 100 per cent.

(i) Generating plant equipment

The manufacture of this equipment, which includes steam and gas turbines, generators, and boilers, requires advanced technology as well as feeding industries to supply components and parts. These requirements are beyond the capabilities of the country.

As seen from the above, three factors have affected the establishment or limited the scope of the electric power equipment industry in Syria.

(i) Viable manufacturing capacity exceeds the domestic market.

(ii) The industry requires investments beyond the capabilities of the country.

(iii) Lack of availability of materials and parts required for manufacturing electric power equipment.

Only one large-scale enterprise, in the public sector undertakes the manufacturing of steam boilers in the Syrian Arab Republic. This is the General Construction Company for Metallic and Mechanical Industries, in Adra, near Damascus.

One of the main items produced by the Company is steam boilers, with the following capacities: 1, 2, 4, 6, 8 and 10 ton/hour.

The Companys production in 1975-1980 was as follows:

Unit/yr	1975	1976	1977	1978	1979	1980
Ton	115	64	174	137	114	20 (boilers).

2.9 Tunisia

2.9.1 Development of industry

The main developments in the manufacturing industry, which occurred in the period 1962-1981 in the public sector, were the establishment of the iron and steel factories and foundries plus the automation programmes. The private sector underwent nationalization of all factories which were in foreign hands. The manufacturing sector reported a 13 per cent growth of GDP in the

period 1962-1969. The Fifth Development Plan (1977-1981) achieved a higher percentage, making a contribution of 19 per cent to GDP growth rates.

The government investment in this sector, based on allocated funds, was 1.5 per cent of total investments in the Third Plan, 2 per cent in the Fourth (1973/1976) and 2.5 per cent in the Fifth (1977/1981).

The low investments allocated for this sector resulted in a negligible effect on the economy, and the only gain cited was providing more work opportunities and employment. (see table 19). In general, attempts to manufacture capital goods have not been very encouraging in Tunisia, not even in the assembly sector. The main constraints are attributed to limitations of the national market and the local intermediate products, lack of skilled manpower and training facilities, incompatability of vocational training with manufacturing needs and lack of manpower mobility between industrial units. Many other constraints were observed such as poor assimilation of technology, lack of standardization and quality control, affecting the quality of imported raw materials and manufactured products, plus absence of R and D and supportive technical assistance. All these factors affected the performance and productivity of established organizations and the quality of products.

Solutions have been found to some of these obstacles including increase of local content and markets through a system of compensation, that is, insisting on assembly operations to manufacture items in a larger quantity then required locally and exporting the surplus for use abroad through involved foreign partners or enterprises for their use abroad. This way the manufacture of capital goods such as cement mixers, shovels, agricultural machinery, railway freight cars, trailers, and material handling equipment, which requires simple technology and skills and low labour costs, can compete in export markets.

The Sixth Development Plan (1982/1986) gives due importance to the manufacturing industry, especially the mechanical and electrical sectors. The allotted investments in the plan for the manufacturing sectors are 1,600 million Tunisian dinars, that is 19.5 per cent of total investments, compared with 816 million dinars and 18 per cent in the Fifth Plan. Twenty-four per cent of the allotted investments are marked for the mechanical and electrical sectors compared with 13.2 per cent in the previous plan. The growth of manufacturing value added is expected to increase at a rate of 10.5 per cent annually, compared with 9.7 per cent annual growth rates in the Fifth Plan. This will increase the contribution of manufacturing value added to the growth of GDP from 20 per cent in the Fifth Plan to 26 per cent in the Sixth Plan, (table 20).

The growth in production is projected to reach an average of 14 per cent annually, relative to 13.9 per cent in the Fifth Plan (see table 21).

In the mechanical sector, production will increase at the rate of 19.3 per cent relative to 20.6 per cent in the Fifth Plan, taking into consideration that a number of units will start production, especially car assembly units and car equipment production and the production of special facility tools, wood tools, diesel engines, tractors and agricultural tools.

In the electrical industries the rate of growth in production will be 14.3 per cent, compared with 21.1 per cent in the Fifth Plan; this will be achieved by making better use of available production activities, and taking into consideration the expected increase in local demand and possibility for exports (see table 21).

The Sixth Development Plan includes improvements to be made on the investment laws and administration controls over all applications for the import of capital goods, to provide opportunities for ensuring that no items or parts are imported which could be made in the country. One main decision was to avoid turnkey projects and ensure that all projects incorporate as many nationally made parts as possible. Engineering construction is expected to show the greatest growth rate, with a projected rate of 28.1 per cent annually.

The public sector

The public sector manufacturing units are limited in number. They are only 5 per cent of the total industrial manufacturing organizations (including the metalurgical, mechanical and electric industries) which are over 350 organizations. More than 41 per cent of the industries work-force, that is 10,000 out of 24,000, are in the public sector. This sector includes all manufacturing activities, which require high investments, such as the automated factory at the Al-Sahil, the model centre for tools and the car assembly factory.

The industrial public sector organizations were established in three stages: the first stage was in 1961-1972, when the public sector underwent great development in investments; the second stage was in 1972-1981 and the third stage started in the Sixth Development Plan (1982/1986). The private sector manufacturing organizations were established in the second stage (1972-1981), with the exception of organizations established before independence, which were nationalized.

2.9.2 Structure of industry

The main Tunisian capital goods industries at present fall under the following sectors: details of manufacturing companies are found under the following sectors and subsectors (see tables 24 to 26).

- Agricultural equipment such as ploughs, discs, harrows, tractors, trailers, tank trailers and diesel engines; Machine tools, such as metal cutters and metal bending machines, pumps of various types; Material handling equipment, such as conveyers, roller and bridges and lifting jacks;

- Automotive: passenger cars, trucks, bus assembly and diesel engines;

- Construction equipment, such as dumpers, cement mixers, building cranes and lifts;

- Heavy metal fabrication, boilers, industrial furnaces, and heat exchangers;

- Electrical equipment, electric motors and cables, circuit breakers, transformers and heaters;

- Machine tools;

- Agricultural equipment, tractors, harvesters and balers;

- Railway equipment, wagons and containers.

2.9.3 Automotive industry

(a) Commercial vehicles

The assembly of vehicles in Tunisia is extremely fragmented with an output in 1980 of around 8,000 passenger cars and trucks. This is equal to about 80 per cent of the local requirements for passenger cars, and pick-ups, but just over 10 per cent of its demand for trucks. The manufacturing companies are:

- The Societe Tunisienne de l'Industrie Automobile (STIA), established in 1961, assembles vehicles carrying the names of nine different manufacturing brands. Annual output is only around 10,000 units. Peugeot accounts for the largest share, with around 5,000 units of its 404 estate cars produced each year. Renault cars and light commercial cars account for about 20 per cent of total output. STIA also produces small Citreon commercial vehicles, Fiat, Mogirus, Ford and Renault trucks and Ford and Skoda buses.

- Early in 1982, General Motors set up a company to build cars and trucks at Karouan. General Motors holds 20 per cent of the capital in the new venture, with Isuzu, its Japanese partner, holding 10 per cent, and Tunisian private investors 70 per cent. Production was to start in 1984. No further information on developments is available.

(b) Diesel engine manufacturing companies

Three companies produce diesel engines: the main company is Atlas Motors, which has a manufacturing licence from Lister, United Kingdom.

The details of each company's products, designed and actual production are as follows:

Company/product	Designed capacity	Actual production (1982)
- Atlas motors		
7 and 8 HP	1,500	800
11 HP	1,000	450
23 HP	500	100
- The Tunisian Motors Company (SOTUMO)	6,500	3,900
- Complex Mecanique Tunisie	6,500	-

Source: Arab Industrial Development Organization, capital goods industries in the Arab world up to the year 2000, (1984).

2.9.4 Construction equipment industry

- Nine companies in this sector produce construction equipment and five companies manufacture various kinds of pumps. The names of these companies, their product mix, annual designed and actual production are given below:

Company/product	Designed capacity	Actual production
1. Turburbo machine		
- Dumpers	400	50 (1982)
- Cement mixer	400	100 (1982)
- Crushers	20	15 (1982)
2. Africa Industrie		
- Dumpers	100	30 (1981)
- Cement mixers	200	70 (1981)
- Building cranes	30	15 (1981)
- Building lifts	40	25 (1981)
3. Magreb motors		
- Dumpers	-	300 (1981)
- Cement mixers	-	550 (1981)
- Building cranes	-	50 (1981)
4. SACEM		
Electric pumps	-	1,500 units (1982)
5. Societe Industrielle du Nord		
- Pumps	-	1,000 units (1980)
- Hydraulic cranes	-	50 units (1982)
6. Africa Industrie		
- Centrifugal pumps	3,000	1,500 units (1981)
7. Hydromeca		
- High pressure pumps	1,300	-
- Lifting jacks	4,300	-
8. Hydro mecanique		
- Pumps	5,000	-
9.. INCO Manutention		
- Roller bridge up to 25 tons		12 units (1982)

Source: Arab Industrial Development Organization, capital goods industries in the Arab world up to the year 2000, (1984).

The Africa Industrie is a private sector company, with a capital of 150 million Tunisian dinars. It is located in the new industrial area. Established in 1974, it started production in 1977.

The Company employs 49 specialists in the different administrative, scientific and engineering posts. All employees are nationals. The Company's products include dumpers, cement mixers, building cranes, building lifts and centrifugal pumps.

2.9.5 Heavy metal fabrication industry

One company only (Chauvec) produces in this sector. Its products and designed capacity are: boilers, 440 units, and burners, 730 units. No further information is available on this sector.

2.9.6 Electric equipment industry

Electric breakers equipment

The Tunisian companies provide approximately 45 per cent of the local markets' needs, mainly for household use. Some examples are:

- The Electric Equipment Industrial Company, which manufactures the low pressure equipment and produces from 10 to 23 ampere units;

- The Tunisian Electrotechnical Company, which produces from 9 to 80 ampere units (contactors);

- The Tunisian Electromechanical Company (STINEM), which produces 10 to 32 ampere and 36 kw fuse units;

- Circuit-breakers, contactors and fuses are produced by the above-mentioned companies plus the TUNELEC group, TET, FABRELEC and ACEM. Most of the used technologies have been bought through patent licence agreements from Italy (TICINO) and France (LEGRND, TELEMECANIQUE - MERILN, GERIN) (see table 27).

Electric and telephone cables

Three companies produce in this sector; their capacities exceed local needs and are only used up to 30 per cent (see table 28).

Transformers, motors and electric heaters

Transformers are produced by the Tunisian Electromechanical Industrial Company (SAGEM) since 1967. It covers the local needs. The percentage of local content is over 35 per cent.

Three other companies produce low voltage transformers. These are:

- The Tunisian Electromechanical Company;

- Transformers;

- The Tunisian Company (Assir).

The Tunisian Company for Electromechanical Engineering (SAGEM); is a mixed sector company, with a capital of 1 million Tunisian dinars. SAGEM was established in 1966 and started production in 1967. The Company's share-holders are distributed in the following manner: foreign 12.85 per cent; nationals 0.24 per cent; Arab private shareholders 38.06 per cent; Arab public shareholders 48.85 per cent. The employed manpower in 1980 was 350 nationals.

Electric motors from 0.5 to 25 hp are also being produced by SAGEM with a local content of 52 per cent. Production covers the local demand. SAGEM plans to increase its capacity to produce 50 hp units, with a total annual production of 12,000 units. Electric and solar heaters are produced by the Company and production covers local needs. Another company, SEREPT, also produces solar heaters.

The data below on product distribution, designed capacity, actual production and sales to local and Arab markets for 1983 were provided by national sources:

Products	Designed capacity	Actual production	Local sales	Arab markets
- Transformers	3,000	2,250	994	116
- Electric water heaters	12,000	8,100	8,164	-
- Electric motors	5,000	5,000	4,890	-
- Electric pumps	2,000	900	803	-

Additional information is provided on electrical equipment producing companies as follows:

(a) The electric and telephone manufacturing company (Chakira) is a private sector company, with a capital of 1.7 million dinars; it was established and started production in 1963. The company produces telephone and electric cables plus other products. The designed capacity is 16,000 tons of cables, but the actual production in 1983 did not exceed 5,000 tons. The products are sold locally and in the Arab and foreign markets. Total employment is 230; all employees are nationals, with 35 in administrative posts, 30 scientists and 5 engineers. The technology used is provided by an American company.

(b) The Electric Equipment Industrial Company (SIAME) was established in 1976 and production started in 1978. The shares are distributed between the public and private sectors; 75 per cent of them are owned by the Tunisian Government. It produces electric meters and circuit breakers, in addition to solar energy equipment. The designed capacity is 100,000 metre units and 50,000 circuit breakers units. In 1983 the company produced 90,000 metres and 40,000 units of circuit breakers. The total number of employees in 1983 was 153, all nationals. They included 5 administrators, 5 engineers, and 16 economists. The technology used is from ISKAA Commerce (Yugoslavia) and Marlin Gerin (France).

2.9.7 Machine tools industries

Two companies manufacture machine tools, Invecta and SIN.

The Societe Industrielle du Nord (SIN), is a national private sector company, located in the industrial area. Established in 1972, it produces metal cutters, pumps and hoists. The technology used is Italian and French (OFFICINE PICCINI and LASPA). The following information on designed capacity, production and local sales in 1983 was given by the Company on its three main products.

Product	Designed capacity	Actual production (unit) 1983	Local sales (unit) 1983
Metal cutters	2,000	1,500	1,500
Pumps	500	500	500
Hoists	50	50	50

SIN employed in 1983, 6 administrators and 3 engineers. The total number of employees was 59.

The Company's products are used by the local industries. The company reports difficulties with suitable raw materials and spare parts provisions. Training of employees is undertaken both in-house and abroad, mainly in the technology owner company.

2.9.8 Agriculture equipment industry

Four companies manufacture products related to this sector. They are as follows:

Company/product	Designed capacity	Production
Complex macanique de Tunisie		
- Tractors up to 100 HP	2,200	45 (1982)
- Combine harvesters	100	
- Balers	200	
- Chopper/loaders	100	
- Cutters, rollers	400	
SOFOMECA		
- Parts for ploughs, combine harvesters (foundry products)	5,000 tons	expansion
Grand Atelier du Nord		
- Poultry farming equipment		6,000 tons (1980)
Huard Tunisie		
- Ploughs, etc.		Expected production (1983)

Source: Arab Industrial Development Organization, capital goods industries in the Arab world up to the year 2000, (1984).

Foundary and Mechanical Company (SOFOMECA)

The detailed information available on SOFOMECA describes the company as a private sector company with shares distributed as follows: 9.8 per cent public, 35 per cent national and 45.4 per cent Arab.

The Company, was established in 1966, manufactures all kinds of moulding parts in cast iron (capacity of cast iron foundry is 4,000 tons per year), steel and non-ferrous castings for various industries, (capacity of steel foundry is 3,000 tons per year).

The main products are the foundry and steel trailers (bogies). The production in 1983 of trailers reached 120 units. As for the foundry parts, 5,135 tons were produced. Some of the foundry products are exported to Arab and foreign markets: the total volume of exports in 1983 was 952 tons.

The Company employs 550 nationals. There are 14 in administration, 15 engineers, one chemist and 5 economists, all with first and second degree levels of education. Some 176 employees have vocational training, and the rest are manual workers.

2.9.9 Railway equipment industry

Two companies manufacture railway equipment. The first is the GABUS complex for metal industries (ACMG), which is a private sector company with a capital of 2.5 million Tunisian dinars. Established in 1976, its production started in 1980. It produces two main products : railway wagons and containers. The Company provided the following information on its designed capacities, actual production and local sales for 1983:

Product	Designed capacity	Actual production	Local sales
Railway wagons	365	160	160
Containers	905	533	530

The other company, SOFOMECA, produces bogies for railway wagons. Production for 1983 was 120 units. ACMG employs over 478 employees, out of which 5 are administrators, 25 engineers and 2 economists. Thirty five employees have higher degrees, while some 443 have vocational training only.

Table 17. Annual investments in manufacturing industries in Tunisia
(in thousands of Tunisian dinars)

Sector/year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
- Metal	342	941	1411	1216	1471	2540	5059	7466	8514	8914	7731
- Ship and repair	4	47	78	627	478	557	370	550	630	1330	1705
- Mechanical electrical	397	367	399	936	1108	2211	2475	2856	4361	4825	7900
- Household equipment Telephones and electronics	336	488	733	1619	1940	3136	3210	7364	6079	6825	5441

Source: Complied by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 18. Investments in the manufacturing industry in Tunisia
(in Tunisian dinars)
(Comparison between Fourth and Fifth plan)

Industry	Fourth Plan (million dinars)	%	Fifth Plan (million dinars)	%
- Food and agriculture	59.2	20.8	160	9.6
- Construction material	82.1	28.9	169.4	33
- Electricity and mechanics	31.6	11.1	107.6	13.2
- Chemical	46.4	16.3	155.9	19.1
- Textile and leather	45.5	16	73	8.9
- Others	19.5	6.9	50.2	6.2
- Total	284.3	100%	816.1	100%
- Public sector share Percentage of total investments	47%		61%	
	17.8%		18%	

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 19. Industrial employment in Tunisia according to Fourth and Fifth Development Plans

Industry	Fourth Plan	Fifth Plan
- Food and agriculture	6,750	13,500
- Construction material	3,900	14,800
- Electrical and mechanics	6,200	15,000
- Chemical	2,050	3,000
- Textile and leather	34,000	29,000
- Others	5,700	87,400
Total	56,600	162,700

Source: Complied by Joint ESCWA/UNIDO Industry Division, based on national sources

Table 20. Investment according to Fifth and Sixth Plans in Tunisia
(in million dinars)

Investments	Fifth plan	Sixth plan
- Steel	8,8	33,7
- Mining	6,2	31,5
- Metal manufacturing	37,9	75,6
- Ship manufacture and repair	3,4	6,0
- Mechanic manufacturing	19,9	180,8
- Iron metal	5,1	16,7
- Electrical industries	26,3	40,7
Total	107,6	385,0

Source: Compiled by Joint ESCWA/UNTDO Industry Division, based on national sources.

Table 21. Manufacturing growth rates in Tunisia
(Comparison between Fifth and Sixth Plan)

Production growth	Fifth Plan percentage	Sixth Plan percentage
- Steel manufacturing	6.0	5.2
- Mineral manufacturing	3.0	5.9
- Metallic manufacturing	14.8	14.3
- Ship manufacturing	7.8	14.0
- Mechanic manufacturing	20.6	19.3
- Machine tools	21.6	14.4
- Electrical manufacturing	21.1	14.3

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 22. Electric power equipment production in Tunisia

Production (thousand units)	1981	1986
- Generators	3	6
- Water heaters	13	20
- Meters	120	140
- Batteries	235	420
- Television	92	130
- Radios	65	92
- Refrigerators	58	80
- Cookers	46	81
- Electricity cables (1000 tons)	5	8
- Lamps	5	12
- Private cars	4	11
- Small freight cars	6	13
- Trailers	1.7	2
- Buses	370	400
- Steam engines	4.4	7.2

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 23. Tunisian companies in the capital goods and engineering industries, and forms of technology transfer

	Establishment	Estab. date	Products	Form of technology transfer
1.	Tunisian car manufacturing company	1961	Cars and trailers	Technical assistance and production supervision
2.	The automated tools centre	1975	Machine tools	Establishment experience and limited foreign technical assistance
3.	The metallic industries complex (in Gabus)	1976	Metallic construction tanks, wagons, railroads and maintenance	Establishments experience and limited foreign technical assistance
4.	The foundry and mechanical company	1966	Railway parts, cement factory equipment and various iron and steel works	Patentcy
5.	The Tunisian company for mechanic manufacturing and ship repair	1963	Mechanical manufacturing spare parts	Establishments experience plus limited foreign technical assistance
6.	Electrical tools and equipment manufacturing company	1976	Electricity meters, breakers, disconnecters and waterheaters (solar)	Patentcy from Yugoslavia and France
7.	(Al-Sahil), coast mechanical factories	1962		Turnkey
8.	Tunisian engines company	1964		Patentcy (Federal Republic of Germany and Finland)
9.	Tunisian electrical industries	1968		Patentcy (Italian and American)

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 24. Tunisian companies in the capital goods and engineering industries

(Subsector: mechanical works)

Establishment	Date of Estab.	Sector	Products	Source	Form of Tech. trans	Labourers	Engineers	Control and adaptation capacities: Research	Procedures	Quality control
Hydromechanic	1977	Private	Hydraulic for all types of trucks and trailers	France	Patentcy	70	2	Good	Good	Good
General Company for Refinery Manufacturing	During the Sixth Plan	Private	Oil refineries	France	patency	75	1	Unavailable	Average	Average
Corona for Cooler Manufacturing		Private	Coolers	Federal Republic of Germany	Patentcy	n.a.	n.a.	Unavailable	Average	Average
Hydromechanic	1977	Private	Pumps, agriculture machines	Italy	Patentcy	52	1	Suitable	Suitable	Average
Mom Company	During the Fifth plan	Private	Tools scrap, and metallic conducters	Italy	Patentcy	26	n.a.	Suitable	Average	Unavailable
Cables and Coils	During the Fifth plan	Private	Aluminium pipes and sewerage pipes	Italy	The estab.	65	1	Suitable	Average	Average
The Tunisian Mechanical Complex	1982	Public	Tractors, agricultural equipment	Federal Republic of Germany	Patentcy	1,069	n.a.	Good	Good	Good

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 25. Tunisian companies in the capital goods and engineering industries

(Subsector: electric equipment and transformers)

Establishment	Date of Estab.	Sector	Products	Source	Form of Tech. trans	Labourers	Engineers	Control and adaptation capacities: Research	Procedures	Quality control
Tunisian Co., for Electrical and mechanical industries	1968	Public	Elect. transformers from 16-200 KW Electr. motors Electr. pumps	Italy & self dev.	Patentcy	340	7	Suitable	Suitable	Suitable
Electrical Equipment Co.	1977	Public	Electricity meters Circuit breakers Solar water heaters	France via Yugoslavia	Patentcy	185	5	Suitable	Suitable	Suitable
Transformer	1976	Private	Domestic transformers Industrial pressure Transformers	Establish-experience	Adaptation	30	1	Average	Non-existent	Suitable
Wire Manufacturing Co.	Fifth deve- devevlopment plan	Private	Covered wires for Electr. Generator and motors	Establishment experience		20	1	Suitable	Unavailable	Suitable
Electric Cables Co. (Chakira)	1963	Private	Electric cables Telephone cables	Establishment experience		200	2	Suitable	Suitable	Suitable
Tunisian Cables	1978	Private	Electricity cables	Establishment experience		173	1	Unavailable	Suitable	Average
Kendeel	Fifth deve devevlopment plan	Private	Electricity buttons	Establishment experience		45	1	Unavailable	Unavailable	Average

Sources: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 26. Tunisian companies in the capital goods and engineering industries

(Subsector: welded structures)

Establishment	Date of Estab.	Sector	Products	Source	Form of Tech. trans	Labourers	Engineers	Control and adaptation capacities: Research	Procedures	Quality control
Tunisian Co. for Trailer Structures	1976	Private	Transport trailer structures	Sweden	Patentcy	85	2	Suitable	Average	Suitable
Marine and Industrial Development Co.	1930	Private	Metallic structures Pipes manufacturing	Establishment experience	-	300	4	Suitable	Average	Suitable
General Manufacturing Co.	1946	Private	Pipe manufacturing Metalic Structures Oil storage tanks Liquid gas, storage tanks	Establishment experience and French assistance	Technical assistance	300	6	Good	Suitable	Good
Marine Metallic Const. Manufacturing Co.	1974	Private	Metallic construction	Establishment experience	-	300	5	Suitable	Suitable	Suitable
Tunisian Co. for Petroleum Construction	1978	Public	Petroleum and gas pipes Petroleum plant works	French assistance and self development	Technical assistance	150	3	Suitable	Average	Average
Metallic Manufacturing Co.	1969	Private	Metallic pipe manufacturing for petroleum transport	Establishment experience	-	10	1	Suitable	-	Good
Marine Constructions Co.	1974	Private	Marine construction Boat manufacturing Wagons Storage tanks	Establishment experience	-	120	1	Suitable	Suitable	Average
Tunisian Co. for Metallic Constructions	1946	Private	Metallic structures Storage tanks	Establishment experience	-	230	3	Suitable	Unavailable	Unavailable
African Manufacturing Co.	1974	Private	Cranes Mixers Others	Establishment experience	Adapted	50	1	Unavailable	Unavailable	Unavailable
Northern Manufacturing Co.	-	Private	Cranes Mixers Pumps Others	Establishment experience	-	50	1	Average	Unavailable	Average

Table 26. (Continued)

Establishment	Date of Estab.	Sector	Products	Source	Form of Tech. trans	Labourers	Engineers	Control and adaptation capacities: Research	Procedures	Quality control
Metallic Construction	-	Private	Iron structures Factory construction All types of wagons	Establishment experience	Adapted	200	1	Suitable	Average	Average
Steel (Structures)	1970	Public	Iron structures Factory construction	Denmark	Technical assistance	250	6	Good	Good	Good
The Large Factories (North)	1975	Private	Poultry breeding equipment Animal food factories	Establishment experience	-	75	6	Good	Good	Good
Structures	1983	Private	Metallic structures Factory constructions	France	Patentcy	45	3	Good	Good	Good
Technical Metallic Co.	1934	Private	Metallic structures Factory construction Foundary	Establishment experience	-	300	3	Good	Suitable	Suitable
Mawarid/Tunis	1981	Private/ Joint	Farming equipment	France	Patentcy	130	2	Suitable	Unknown	Unknown
Metallic Manufacturing	1976	Private	Farming wagons	-	-	15	-	Below average	Unavailable	Unavailable
National Metallic Manufacturing	1981	Private	Union types of transport wagon	Federal Republic of Germany	Patentcy	56	2	Average	Below average	Unavailable
General Co. for Metallic Manufacturing	1981	Private	Small and medium-sized wagons	Establishment experience	-	85	-	Below average	Unavailable	Average
Industrial Company for Crane and Trailer Equipment	1970	Private	Small and medium-sized transport wagons	France	Patentcy Independence	300	4	Good	Average	Average
INOO	1978	Private	Moving bridges for workshops	Federal Republic of Germany	Reproduction	32	1	Average	Unavailable	Average
Tunisian Co. for Ship Construction	1983	Public	Ship construction Mechanical automation	Various services	Technical assistance	1,300	4	Below average	Below average	Unavailable
Tunis for Metallic Construction	1945	Private	All types of land transportation wagons	France	Patentcy	70	-	Above average	Unavailable	Unavailable

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 27. Electric breaker equipment in Tunisia

Equipment	Manual quantities	Value (thousands of Tunisian dinars) 1984	Local production	Capacity of local production percentage
Household equipment	700,000	2,000	95	100
Low pressure disconnecting (units)	200,000	2,700	33	500
Low pressure connecting (units)	60,000	1,500	33	50
Low pressure plates	3,000	4,000	60	90
Medium pressure disconnecting (units)	1,200	800	80	95
Medium and low pressure (units)	1,000,000	500	20	50
Medium pressure disconnecting (units)	50	250	-	-
Transfer centres	200	1,100	80	95
Medium pressure plates	100	2,000	-	-
High pressure disconnecting (units)	100	1,250	-	-

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 28. Tunisian cable market

Types	Annual consumption		Annual local production (percentage)	Local production capacity (percentage)
	Weight	Value (thousands of Tunisian dinars)		
Low pressure cables	8,000 tons	12,000	90	90
Medium pressure (10 KV pressure cables)	810 tons	1,620	20	100
Medium pressure (15 KV pressure cables)	230 tons	500	-	possible increase if required
High pressure cables.(Unidentified) (connected to the big projects and fully imported)				
Stripped conducting wires	1,100 tons	2,200	10	100
Telephone and television cables	1,100 tons	4,000	60	100

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 29. Tunisian transformers market and production

Type	Local market		Local production	Future local production
	Quantity units	value	Quantity units	Quantity units
Three-phase transformers	1,000	2.5 (million dinars)	3,000	6,000
Single-phase transformers	2,000	2 (million dinars)	500	3,000
Percentage of local integration = 35%				

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

PART THREE

CURRENT TECHNOLOGICAL CAPABILITIES

The type of assessment of technological capabilities called for in this study could not be carried out without relying on detailed information which could be solicited only by means of specially designed questionnaires, in-depth interviews with concerned officials and/or background papers prepared by local consultants about their own organizations and countries. The technological capabilities in question which were identified in Part One cannot be properly evaluated without inputs from the organizations concerned.

The assessment exercise in this study is consequently confined to Algeria, Egypt, Jordan, Morocco, the Syrian Arab Republic and Tunisia - the countries which provided necessary information. Information received from Algeria and Egypt was the most complete. For this reason and because Egypt has the most extensive and mature capital goods and engineering industry in the region, the study emphasizes the Egyptian and Algerian experiences. In this context it should be mentioned that the experiences of Iraq and Saudi Arabia could have enriched this study had it been possible to solicit the information necessary to assess their technological capabilities. It is hoped that such information will be made available in the future and that this report will be updated accordingly.

As for the rest of the countries, it has been shown in Part Two that the level of industry which they possess is not significant. The development of their industries will always be constrained by the size of their markets and the size of investment needed to establish those industries. Their hope rests in the realization of regional or subregional co-operation. Nevertheless, it is obvious from part two that in many countries dependence on foreign technologies prevails in the smallest manufacturing establishment and at the least complex level of technology.

3.1 Algeria

3.1.1 General policies for technology transfer

The Algerian establishments, encouraged by the Government, have undertaken a number of activities for technology transfer within the past years. The process of technology transfer in Algeria is not controlled by special laws or measures such as found in other countries (like Brazil). There are implicit terms that have to be adhered to even though they are not written and in this sense the process of transfer of technology has to abide strictly by these terms. This process is controlled by specialized agencies such as the ministry or the monetary fund and the industrial ownership authority. This situation has made the technical negotiations much simpler since they have fewer restrictions.

The Algerian organizations have normally:

1. Adhered to using known and tried technologies and refrained from buying new and unknown technologies;

2. Rejected any restrictive conditions such as export prohibitions or prohibitions on acquiring similar technologies;

3. Rejected restrictions on technology transfer within Algeria, so that they have the right to provide the technology to other Algerian companies, which makes this procured technology a national possession;

4. Refrained from accepting terms which impose any procurement from the licenser, especially in the case of raw materials available in the country;

5. Signed long-term contracts (10 years);

6. Negotiated financial conditions.

The Algerian Government, though convinced of the continuous need to obtain foreign technology, has established a programme with the aim of developing technologies locally. Therefore, they first limited the foreign technical assistance which in some cases (sectors) is very high in capital cost and which persisted for a longer period than actually planned; the delay proved that the technology transfer process was not implemented as planned.

The Government has established special sections to control new technology contracts in the form of technical assistance contracts. The concerned organizations or establishments are forced to provide a special programme by which they replace foreign experts with local skilled employees within a limited period (not more than four years).

The Government also encouraged manufacturing establishments to prepare new products and innovate an R and D programme and apply it at the level of each production unit. The established special organizations such as the Scientific and Technical Research Centre, the Industrial Ownership Authority, and the Quality Control Authority provide the means to develop the process of technology transfer.

The Government also encourages the beneficiation of local raw materials and initiation of suitable technologies. For example, the capital goods and construction equipment industries, depending on their own capabilities to manufacture equipment, have been able to treat the local raw materials and use them for construction equipment. The capital goods industries co-operated with the agro-industries to develop equipment such as harvesting machines suitable to local needs.

The selection of technologies is made either internally or with national help, and the forms of contracts are mainly licences. The methods adopted in Algeria since independent have passed from the split-up type to the product in-hand type. The split responsibilities between the national promoter and the foreign partners varied according to the method chosen, the role and prerogative of the national company being greater or lesser depending on the individual case. This process was greatly affected by the slow development of skilled workers, which did not and could not progress at the same rate of project implementation needs. This resulted in the gradual turning to global methods of carrying out (turnkey) projects. The following technical factors favoured turnkey contracts:

- Lack of experienced technicians and management cadres;

- Complexity of management activities in the case of split-up engineering.

The experience of the years from 1975 to 1980 does, however, show that some Algerian national companies have been able to get started on a regular development process of their own. Skills in overall design, civil engineering and the manufacture of secondary equipment, the manufacture of structural steel boiler work overhead cranes, hydromechanical equipment, agricultural machinery, and industrial vehicles were all developed by national companies, yet no national structures have been able to generate substantial manpower resources capable of tackling process design and the manufacturing of electro-mechanical process machinery. The national engineers and technicians have been preoccupied with day-to-day tasks of management and production techniques. One estimate shows that 37 million man-hours were spent in the area of design and engineering in 1980. This is equivalent to 18,500 engineers and technicians working for one year. However, the total number of workers in the Algerian industrial engineering firms was estimated at 5,000 only, which explains the fact that in the same year more than two thirds of engineering man-hours were subcontracted to foreign companies, mainly in the project implementation stage.

3.1.2 Legal issues and the private sectors role in technology transfer

(a) The law concerned with general transactions

The national Algerian organizations are subject in trade procedures to certain laws which describe the procedures of tenders and choice of partners and some conditions for trade agreements. This law, in relation to the processes of technology transfer, neglects some elements related to technology contracts such as licence contracts. The special payment terms do not specify royalties as one measure of payment, nor are there any terms in the law or any other government document relating to what should be requested from the seller as part of a private contract in the technology transfer process.

(b) Private sector and technology transfer

Foreign trade is controlled by the State. The State depends for its transactions on the national organizations (public sector). The private sector does not have the right directly to import products or technology. The private sector can import products through the public sector organizations and system, but in relation to technology transfer, no operation has been implemented, because the government has not alloted in the annual importation programmes any specific figures for technology procurement for the benefit of the private sector. Therefore the private sector manufactured products are produced through old methods which affects the quality and prices of these products.

The methods to be used by the private sector to purchase technology are not clear, but since the government encourages this sector, thorough loans and other facilities, to invest in the industrial sector it is necessary to

promote clear guidelines in this field. This matter will facilitate the governments' control over imported technologies, and avoid obsolete ones, since it is well known that the sale of some technologies is prohibited in developed countries, while there are still some foreign companies who try to sell these technologies to developing countries.

3.1.3 Role of related capital goods organizations

As mentioned above, the Algerian Government has established a number of organizations related directly or indirectly to the technology transfer process. In this section some and not all related institutes will be reviewed, i.e., the different organizations concerned with research and follow-up on the capital goods industries' technology transfer process.

(a) The National Council for Scientific and Technical Research

This organization has been established lately, under the authority of the first ministry. Its main objective is to control the national comprehensive policies for scientific and technical research; for that it has to co-ordinate between all universities, institutes and national organizations to achieve a comprehensive programme suited to the national needs. This co-ordination can be implemented within the periodic meetings undertaken to organize the annual programmes for scientific and technical research.

No assessment can be made of the Council's achievements, since it has newly undertaken its responsibilities in this field, yet its establishment in itself is an accomplishment since it filled the gap which has been felt by the concerned organizations.

By forming the Council in this manner, the universities' activities can be oriented towards undertaking research related to the activities of the manufacturing organizations and the producing sector will be forced to master and develop the technologies used in the country.

(b) The National Institute for Standardization and Industrial Ownership

This Institute was established in the early 1970s under the authority of the Ministry of Industry and Energy. A decree was issued later placing the Institute under the Ministry of Planning.

In the past 15 years, this Institute has initiated many activities to reach a unified Algerian standardization, but it has been unsuccessful in its endeavours. In the absence of authorized local or international standardization, the different national companies had to accept the foreign companies' standards, which led to complicated problems in maintenance and spare parts manufacturing. This also complicated work in the consulting and contracting bureaux where engineers and technicians used different foreign standards which led to the procurement of foreign equipment instead of national products.

In the field of industrial ownership, the Institute registered all contracts related to the process of technology transfer; this registration was obligatory for all national organizations and was done with the objective of controlling the contents of all contracts and to ensure that the contracts did

not include any conditions contrary to the government's general policies in this field. However, this control was gradually neglected, since the Institute lacked personnel with experience in the technology transfer process, including its objectives and contractual conditions. Algeria is a member of the international industrial ownership patents organization. The Institute has had continuous contact with this organization and other foreign organizations of a similar nature.

This Institute documents and purchases all foreign documents related to standardization and patent copies. It is the sole procurement agency for the State. However, as mentioned above, its accomplishments in this field have not been up to expectations. The reasons are the initial unavailability of experienced industrial personnel in the relevant fields, though the early establishment of this Institute, makes it feasible at present to launch an active programme to promote appropriate technologies and Research and Development.

3.1.4 Assessment of technological capabilities

Five companies provided information relating to the extent of the development of their technological capabilities, as shown below:

(a) The Steel Structures Company

This company reports that all activities have been performed internally, but that it is not fully equipped to undertake complete jobs in engineering design and product and process design; for that, outside assistance has been sought, either national or foreign. National assistance is used in pre-feasibility studies, in engineering design, construction, R and D and maintenance, while foreign assistance is made use of in pre-feasibility studies, product and process design. This is shown in table 30.

(b) Electric and Telephone Cables Company

Internal capabilities are available for almost all activities except plant design and construction. The national capabilities are made use of here as well as in pre-feasibility and feasibility studies, R and D and maintenance. Foreign assistance is used in engineering and plant design, product and process design and in maintenance. This is shown in table 31.

(c) Machine Tools Company

The internal facilities of the company are able to perform up to 25 per cent of the work-load, feasibility up to 15 per cent, plant design up to 5 per cent, product design up to 40 per cent, process design up to 15 per cent, marketing up to 100 per cent, maintenance up to 90 per cent, R and D up to 5 per cent, and customer services 100 per cent. National capabilities are made use of in all the activities, except maintenance. National organizations undertake up to 40 per cent of the product design activity requirements, 95 per cent of plant design, and 100 per cent of the engineering. Foreign assistance has been used mainly in feasibility studies, engineering design, plant design, product and process design, maintenance and customer services. This is shown in table 32.

Table 30. Technological capabilities of the National Steel and Copper Structures Company in Algeria

Technological Capabilities	Company itself	National organization	Foreign companies
Source of Technology			France
Selection of technology	Yes		
Pre-feasibility study	Yes		Yes
Feasibility study	Yes		
Engineering	Yes		
Factory design	Yes		
Construction		Yes	
Product design			Yes
Process design	Yes		
Maintenance	Yes		
Manufacturing of spare parts	Yes		
R and D	Yes		
After sales service	Yes		
Training	Yes	Yes	Yes
Marketing	Yes		

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 31. Technological capabilities of the National Company for Cable Production in Algeria

Technological Capabilities	Company itself	National organization	Foreign companies
Source of Technology			German Democratic Republic, Federal Republic of Germany, France, Switzerland and Finland
Selection of technology	Yes		
Pre-feasibility study	Yes		
Feasibility study	Yes	Yes	
Engineering		Yes	Yes
Factory design		Yes	Yes
Construction		Yes	
Product design	Yes		
Process design	Yes		
Maintenance	Yes	Yes	
Manufacturing of spare parts	Yes		
R and D	Yes	Yes	
After sales service	Yes		
Training	Yes	Yes	Yes
Marketing	Yes		

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 32. Technological capabilities of the National Company for Machine Tools in Algeria

Technological Capabilities	Company itself	National organization	Foreign companies
Source of Technology			German Democratic Republic
Selection of technology		Yes	
Pre-feasibility study	Yes		
Feasibility study	Yes		
Engineering		National Company for Mechanical Engineering	
Factory design		National Company for Mechanical Engineering	
Construction		Yes	
Product design	Yes	National Company for Mechanical Engineering	Yes
Process design		National Company for Mechanical Engineering	
Maintenance	Yes		
Manufacturing of spare parts	Yes		
R and D	Yes		
After sales service	Yes		
Training	Yes	Yes	
Marketing	Yes		

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

(d) Agriculture Equipment Company

Internal and national capabilities are available and have undertaken all most all required activities, except product and process design. The Company reports that foreign assistance is used in pre-feasibility and feasibility studies, engineering, product and process design. This is shown in table 33.

Table 33. Technological capabilities of the National Company for Agricultural Machines in Algeria

Technological Capabilities	Company itself	National organization	Foreign companies
Source of Technology			German Democratic Republic
Selection of technology	Yes		
Pre-feasibility study	Yes		Yes
Feasibility study	Yes		
Engineering	Yes		Yes
Factory design			
Construction		Yes	
Product design			
Process design	Yes		Yes
Maintenance			
Manufacturing of spare parts			
R and D			
After sales service			
Training	Yes	Yes	Yes
Marketing	Yes		

Source: Compiled by Joint ESCWA/UNDIO Industry Division, based on national sources.

(e) Railway Equipment Company

Internal capabilities are mainly in the production phase of project implementation. They include product design, production, management marketing, R and D, maintenance and customer services. The Company reports

that they have undertaken pre-feasibility and feasibility studies, process design and R and D but they are not well-equipped to undertake such activities completely. In all these activities they have been using foreign expertise (see table 34).

The following remarks are provided by the companies on the extent of the development of their internal capabilities. With regard to agricultural equipment the internal technological capabilities can be very effective when it comes to expansion of mechanical workshops or in designing medium and small plants. The Company has accomplished many technical innovations in the technologies used, though limited, which had an economic and technological effect. One example cited was producing engine bars directly from raw materials in the form of a cylinder, instead of forging and passing on to special facilities in the machine tools industry. The internal technological capabilities are considered to be insufficient and do not involve all the fields, especially since automated projects are difficult to control because the Company does not control the required technologies. The Company has managed to develop some of the production techniques, which gave good results. In the metal structures industries, the internal technological capabilities are considered to be on the weak side. The Company gives its personnel the opportunity to gain some experience by undertaking the required activities. In the cables industries the Company undertakes all activities related to expansion of existing plants, control of new equipment, or undertaking changes on available machinery, depending on its past experience. As for contributions to major projects there is some participation at certain stages. Technological innovations have been made in product promotion and restructuring according to market needs, within the producing units. This is shown in table 34.

Based on the analysis undertaken, it is possible to describe the technological capabilities in these companies as follows:

1. Pre-feasibility and feasibility studies

Feasibility and pre-feasibility studies are undertaken by local companies with the help of engineering units available, national consultants and sometimes with foreign experts, especially in the case of feasibility studies, the railroad and agricultural companies do not have such capabilities internally and depend on national consultancy offices. However with regard to their plans for expansion in the coming five years, they expect to be able to undertake pre-feasibility studies. Both the cables and machine tools companies state that the percentages of internal capabilities in this field is around 60 to 70 per cent, the remainder being acquired through contracts with either national or foreign expertise.

2. Engineering and plant design

It is reported that this capability is undertaken through contracts with national consultancy houses and in some cases requiring advanced technologies with foreign help. Only the work on metal structures depends on internal capabilities. The central engineering division has undertaken some activities in the field of agricultural equipment.

Table 34. Technological capabilities of the National Company for Railway Equipment Production in Algeria

Technological Capabilities	Company itself	National organization	Foreign companies
Source of Technology			
Selection of technology	Yes		
Pre-feasibility study	Yes		Yes
Feasibility study	Yes		Yes
Engineering		Yes	Yes
Factory design		Yes	Yes
Construction		Yes	
Product design	Yes		Yes
Process design	Yes		
Maintenance	Yes		
Manufacturing of spare parts	Yes		
R and D	Yes		
After sales service	Yes		
Training	Yes	Yes	
Marketing	Yes		

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

A summary of the above assessment is shown in table 35.

Table 35: Technological capabilities in the Algerian capital goods industry

Capabilities / Company	Steel Structure Equipment Co.	Cable Co.	Machine Tool Co.	Agriculture Machine Co.	Railway Equipment Co.
Source of technology	F	F	F	F	
Selection of technology	C	C	N	C	C
Pre-feasibility study	CF	C	C	CF	CF
Feasibility study	C	CN	C	C	CF
Engineering	C	NF	N	CF	NF
Factory design	C	NF	N		NF
Construction	N	N	N	N	N
Product design	F	C	CNF		CF
Process design	C	C	N	CF	C
Maintenance	C	CN	C		C
Mfg. of spare parts	C	C	C		C
R and D	C	CN	C		C
After sales service	C	C	C		C
Training	CNF	CNF	CN	CNF	CN
Marketing	C	C	C	C	C

Source: Compiled by Joint ESCWA/UNIDO Industry Division.

Note: C = Capabilities within the company
N = Capabilities within a national organization
F = Capabilities provided by a foreign company

3. Construction and supervision

This is undertaken locally by both national and internal offices. Only the agricultural company reports using help from foreign firms.

4. Process and product design

All companies mention the reliance on foreign help, especially for advanced technologies, but at the same time the companies report that internal capabilities in this field are available and that they have implemented expansion plans independently from foreign help. Plant and customer technical services, marketing, the majority of this work has been and is undertaken internally within each of the producing companies, with the exception of maintenance and R and D. Some help is sought from either national or foreign sources such as laboratories and specialized consultants. The machine tools company specifies the outside contribution to be 10 per cent in maintenance and 95 per cent in R and D.

As for linkages between the different industries in the country, three companies cite examples of co-operation, in R and D, national product integration, quality control and increased productivity. The machine tools industry and the metal structures do not mention any such linkages. The agricultural industry is the only industry that mentions co-ordination with a neighbouring country (Tunisia).

5. Technical difficulties

The two problems that seem to be common to most of these companies are maintenance and availability of spare parts. For solving these problems as well as for the others, there seems to be some dependence on foreign expertise, and on training for the long run. Dependence on foreign technical assistance is also resorted to when new production lines are being installed and in recurring technical disruptions; otherwise there is in general more reliance on internal and national capabilities. All the industries work force are nationals whether in the administrative or in the technical field. One other problem that seems to effect the industry as a whole is quality control.

6. Training

All companies use the national training centres available in the country to complement the internal training facilities; some companies send trainees abroad. The machine tools and railroad companies excluded, they depend only on the internal and national facilities. The training facilities are assessed as satisfactory.

The main fields of training are maintenance, production, finance, marketing and planning. The numbers of trained personnel in capital goods industries in (1969-1980) was as follows:

	1969	1980
Senior executives	320	1,300
Technicians/foremen	680	6,600
Skilled workers	1,800	20,000
Total	2,800	27,900

Source: Meeting on Capital Goods Industries among Developing Countries, Algeria, 1982.

3.2 Egypt

3.2.1 Criteria for the selection of technology

Up to the end of the 1950s, there were no established criteria for the selection of technology. The selection decision was based on many factors including the type of the industry, ownership of the manufacturing establishment, size of the market and the overall conditions of the country.

The automotive industry was confined to assembly and service activities. The automotive companies were completely owned by large foreign companies such as Ford and General Motors or their agents. The companies adopted a technology that depended on the utilization of cheap labour and foreign expertise for complex technical tasks. In addition, most of the research and development activities were undertaken at the facilities of the foreign companies. Similarly, all equipment, machines, components and parts, and raw materials were imported from abroad. As a result of all these factors, the industry did not achieve technological advances for the country.

With respect to the metal fabrication industry, most companies were owned by individuals or small companies. Their technology was geared towards the employment of cheap domestic labour in conjunction with simple machinery, some of which was bought from the British army. Product designs were prepared abroad or in the offices of foreigners residing in Egypt. Some of those designs were imitations of imported products.

The machine tool industry encompassed small enterprises and companies. The technology which was adopted simply called for copying the designs of imported machine tools. It also depended on existing domestic workshops for the supply of castings and forgings, and on importing the mechanical and electrical components and parts such as electric motors and control instruments.

Since the beginning of the 1960s the Government started to formulate and implement development plans. It also nationalized most of the industrial establishments. The technology which was selected was based on criteria compatible with the policies and objectives of the Government. Specifically the criteria included the following elements in order of priority:

- To maximize employment in view of the commitment made by the Government to provide work for every citizen;

- To minimize investment, especially with respect to hard currencies;

- To utilize domestic raw materials and components and, when not available locally, to import them from the socialist countries;

- To improve the balance of payments;

- To maximize the local added value;

- To be compatible with production capacity;

- To minimize production cost;

- To develop the technological capabilities, as a last priority.

Since the end of 1973 a new era emerged. An open-door policy was adopted. The freedom of travel and work abroad was granted. Many joint projects were formed, and many sources of finance became available.

The industrial establishments consequently adopted the technologies which were in harmony with these economic, social and political changes.

In order to assess the present trend in the capital goods and engineering industry with respect to the criteria for technology selection, the General Organization for Industrialization (GOFI) surveyed 12 major companies in 1983. The results indicated the following:

- All companies preferred the least costly technology.

- Two thirds preferred the technology which:

  (a) Was available domestically;

  (b) Was more advanced;

  (c) Was more labour intensive;

  (d) Was more profitable;

  (e) Depended on domestic raw materials and components;

  (f) Helped in producing quality products;

  (g) Helped to develop domestic technological capabilities;

- One third of the companies preferred the technology which:

  (a) Was imported from foreign sources;

(b) Was suitable to the domestic social conditions and to the local environment;

(c) Saved energy.

Regarding the sources of technology, the results indicate that:

- Eighty per cent of the companies preferred the source of technology which could help to develop local technological capabilities, especially the planning and the design functions.

- Seventy-five per cent preferred the sources which were capable of financing the project especially if the equipment were imported from the same source.

- Sixty-seven per cent of the companies preferred reputable sources which would agree to depackage the technology, as well as domestic sources.

- Fifty per cent preferred sources with successful experience in the developing countries or regions, and sources agreeable to train the local work-force.

3.2.2. Modalities for the transfer of technology

Although an important criterion for choosing the modality for transferring technology should be its contribution to the development of indigenous technological capabilities, whether at the project level or at the national level, the past experience of Egypt in this regard indicates that this was not the case. Even now the widespread understanding of the objective of technology transfer is to enable the production units to manufacture or assemble products similar in quality to the products manufactured by the suppliers of technology, and to use their trademarks to facilitate the marketing of the products. Consequently the objective of the majority of contracts that were concluded with the suppliers of technology included obtaining technical drawings and information as well as training the local staff to operate machines and equipment. Rarely did any contract call for obtaining product and plant designs or setting up R and D facilities.

The modalities which have been utilized in the capital goods and engineering industries included the following:

(a) Joint projects in which a foreign company, in partnership with a domestic company, establishes a joint project. The foreign partner supplies the technology and part of the capital, comprising basically machines and equipment. The Egyptian partner supplies the rest. This modality was chosen in the following cases.

(i) The Arab American company for manufacturing vehicles;

(ii) The large boiler project between Stein Miller of the Federal Republic of Germany and the El-Nasr Boilers Company;

(iii) EGEMAC, which is owned by Siemens Co. of the Federal Republic of Germany and the Electrical Transformer Company;

(iv) The Egyptian Equipment Co. for manufacturing the needs of petroleum pipe lines. This company is owned by MECVOY Company of America and the Helwan Company for Machine Tools;

(v) Ferro Metalco Co. which is owned by Ferro Stahl the Federal Republic of Germany and the Egyptian company for metallic construction (Metalco).

(b) Licensing: according to this modality the supplier of technology gives to the licensee some of his industrial ownership rights whether patented or not;

(c) Know-how which includes various information and documents on industrial and technical operations as well as technical reports and scientific results. In addition, it includes information on the design of semi-industrial units as well as production procedures, specifications of raw materials, engineering drawings, etc.

Examples of this modality include:

(i) The trucks, buses, trailers, and passenger cars projects in El-Nasr Automotive Company (NASCO) in collaboration with Deutz of the Federal Republic of Germany and Fiat of Italy;

(ii) The cranes manufacturing project at the Egyptian company for metallic construction (METALCO) in collaboration with [BAYTER] company of the Federal Republic of Germany;

(iii) The electrical transformers and breakers projects at the El-Nasr Co. for transformers and electrical products (ELMACO) in collaboration with F.T. company of France;

(iv) The machine tools manufacturing projects at the Machine Tools Manufacturing Co. in collaboration with Promas Export Agency of the Soviet Union;

(v) The steam boilers manufacturing project at El-Nasr Boiler and Pressure Vessel Manufacturing Co. in collaboration with Bomgart Company of the Federal Republic of Germany.

(d) Importation of components for local assembly: in this case the foreign supplier provides the components and parts and some technical information. The foreign supplier also assists in modifying domestic components and parts and in assembling the final product. This modality normally strengthens the research and design capabilities within the local establishment. An example of this modality is the cranes manufacturing project at the Engineering Projects for Steel Works (STEELCO) in collaboration with several European companies specializing in supplying electrical and mechanical components and parts. Foremost among those are the Bilkankar establishment of Bulgaria, the Demag Company of the Federal Republic of Germany, and the Alfred Morris company of England. On its part, STEELCO manufactures the bodies of cranes and vehicles.

(e) Importation of new-technology machines and equipment: up to the mid-1970s most industrial projects in Egypt encompassed contracts for importing equipment, and regarded equipment and technologies as one and the same. Thus the bids submitted by the suppliers were evaluated in one package comprising the technological, financial and financing aspects. The situation has changed since then. Technological evaluation is performed separately, then the financial implications and financing conditions are evaluated. Examples of this modality include the petrochemical, food, and textile projects in addition to the machine tool project in the early 1960s and the transportation equipment project in the early 1970s.

(f) Contracting foreign experts and expatriates to perform specific tasks or to assist in solving technical problems. Contacts are thus made with foreign companies to send their experts for short periods, or with international organizations, mainly UNIDO and its projects for developing countries such as the Tokten Industrial Consultancy. Contacts may also be made with international inspection agencies such as Lloyds for ship building, and the International Agency for Development of Cables Industry in France for manufacturing electrical cables and wires.

(g) External training of technicians and engineers in foreign factories, specialized training centres, and R and D institutes. In the mid-1970s, the El-Nasr Automotive Co. (NASCO) adopted a training programme according to which the company's technicians were trained for one year in the factory of the foreign company on machines and equipment identical to the ones which would be installed in Egypt. In this way the trainees were exposed to the various aspects of the industrial process including work procedures, interfacing with materials and equipment, and interaction with other people.

3.2.3. Constraints on the transfer of technology

The process of transferring technology in the capital goods and engineering industries encountered many problems some of which have been solved or minimized while others are still unresolved. The main problems are listed below in their respective phases.

(a) Pre-negotiation and contracting phase

(i) Lack of availability of information about the different technologies, their advantages and disadvantages and the necessary local conditions which must be provided in order to select the appropriate technology and to transfer it well;

(ii) Because capital goods projects normally require huge investments and the available local financial resources are limited, Egyptian companies sometimes give top priority to the financing aspect. Thus they may select the technologies from those companies that are willing to finance the projects;

(iii) Sometimes the Egyptian companies were not well versed in the subject matter and were over anxious to start negotiations before preparatory work was done;

(iv) In other cases, the Egyptian companies did not have accurate and complete information about domestic R and D capabilities or the feeding industries;

(v) Last but not least, the Egyptian companies did not know the actual size of the market or the required product specifications or the selling price which would be considered acceptable.

(b) Negotiations and contracting phase

(i) The foreign negotiators invariably were well informed about the Egyptian market, the industrial and research capabilities, the financial situation in the country and all aspects of the Egyptian company concerned;

(ii) The foreign companies did not really wish to provide the Egyptian company with technical assistance in research and development, planning or design;

(iii) The foreign companies were determined to sell all the components and parts necessary for manufacturing the product. Thus they were not inclined to develop and strengthen local feeding and supporting industries;

(iv) The Egyptian companies were not well informed about the experiences of other countries in successfully negotiating and concluding agreements in the capital goods and engineering industries;

(v) The Egyptian companies did not properly utilize the expertise of Egyptian engineers and managers who did have prior experiences in negotiating similar contracts. For one thing, there was no record of those experts;

(vi) Sometimes the Egyptian companies were pressured to terminate contracts with foreign companies. This can be appreciated in view of the fact that most contracts in the capital goods field fell within intergovernmental agreements.

Examples of major weaknesses in the contracts which were concluded include the following:

a. In most cases the contracts did not include the build-up of local capabilities to manufacture components and parts or the role of the foreign company in facilitating it.

b. No real emphasis was given to the development of technological capabilities in the fields of design, research and development, and training.

c. The foreign counterparts' insistence that Egyptian companies buy certain components, at high prices, directly from them and not from the actual manufacturers of those components. Moreover, they offered component, similar to the ones which were available locally, at very low prices in order to harm the feeding industries.

d. The Egyptian companies were not permitted to share the technology among themselves, even when they were willing to pay for it.

e. The Egyptian companies were restricted to selling their products on the domestic market. In some cases they were allowed to export their products to certain Arab countries in whose markets competition was very keen.

f. Some Egyptian companies were paying royalties for patents which had expired

g. The duration of the contracts was excessively long at times, up to 10 years, with no guarantee that the technology would be absorbed.

h. The Egyptian companies did not insist that local materials and components should be used.

i. The Egyptian companies did not have the right to object to any expert sent by the foreign counterpart. The salaries and other benefits for these experts were excessive.

j. The foreign counterpart was not obligated to furnish the information necessary for manufacturing by the companies locally.

k. The foreign counterpart did not furnish technical and engineering drawings and documents which would enable the local staff to absorb the foreign technology and develop its own technology.

l. The foreign companies were free to manage the project and to select the local work-force as they saw fit. They also planned and implemented production activities as they pleased. In spite of all this, the Egyptian companies alone had to face the consequences, including losses.

m. In some cases the Egyptian companies concluded additional contracts according to which they imported equipment which was different from that originally used by the companies.

(c) After negotiations and contracting

The process of absorption and adaptation of foreign technology was hampered by certain basic constraints. For one thing, the objectives of the Egyptian companies were different from those of the foreign companies which supplied the technology. Thus, while the Egyptian companies wanted to increase the ratio of locally manufactured components and parts, the foreign companies wanted exactly the opposite because they gained much more from selling the components and parts than from receiving royalties if these components and parts were manufactured locally. In addition, the foreign companies invariably supplied only those documents which were necessary for operating the machines and equipment. They did not supply documents necessary for manufacturing components and other intermediate parts. Of course the size of the Egyptian market was a major factor in preventing the Egyptian companies from manufacturing certain components locally.

The Egyptian companies, on the other hand, suffered from specific weaknesses. One was the shortage of suitable staff to work side by side the foreign experts during the execution of the project and the start of production (on the job training). Moreover, many of the staff, after being trained, left the project for better job opportunities.

Another weakness was the inadequacy of local R and D capabilities to conduct a comprehensive study of the project. Still another was the lack of sufficient funds properly to equip the factories and the R and D facilities within the companies themselves.

3.2.4. Role of domestic manpower

The reliance of the Egyptian companies on domestic manpower depended to a large degree on the type of the company. The private sector companies relied on local skills to a great extent because of financial reasons.

In the public sector, in the period before 1984, the Egyptian companies were free to conclude contracts, as they saw fit, of up to 3 million pounds. Since 1984 a new policy has been in effect whereby Egyptian companies became obligated to engage local expertise in all phases of technology transfer. Thus for every project, committees were formed to study specific aspects of the project. The first committee identifies and evaluates possible technologies and recommends the most suitable one. The second committee prepares invitation to bids and conditions of contracts as well as required qualifications of the source of technology. This committee encompasses the company which owns the project, the Public Sector Agency or the General Organization to which the company belongs, the research institutes and the universities, the data processing facility, the State Council, and many departments within GOFI. The third committee studies the offers and selects the best one. Out of this committee emerges another committee whose function is to negotiate and contract with foreign sources of technology.

In the mixed sector, the role of local manpower was limited and depended on the respective share of the capital owned by the Egyptian company and its counterpart.

In all sectors the Egyptian companies encountered definite difficulties when they relied on local expertise. Among them were:

(a) Lack of local consulting or engineering capabilities which could deal with the totality of a technical problem;

(b) Lack of information on the local manpower or on how to contact them. To solve this problem GOFI prepared a guide about such people in the industrial sector. The Academy of Scientific Research and Technology prepared a guide about M.S. and Ph.D graduates;

(c) Brain drain: migration of skilled personnel out of the country;

(d) Refusal of the foreign companies to employ local staff in the joint companies. To counter this policy, the Union of Engineers issued a decree

which made it obligatory for foreign companies to engage Egyptian consulting and engineering organizations in all consultancy and design work relating to Government and public sector projects.

The role of domestic manpower in each of the major branches of the capital goods industry is described below.

(i) Metal fabrication industry: With regard to the manufacture of crane bodies, tankers, etc. the available manpower is quite capable of absorbing foreign technology and adapting it to local needs. The country is practically self-sufficient in this field.

In the case of large boilers, pressure vessels, and electrical and mechanical parts of large cranes, the country has the skilled manpower which can absorb the necessary technologies. However, the available manpower is not yet capable of creating Egyptian technologies. Specifically these capabilities include:

a. Selection of appropriate technologies;

b. Product design, and analysis and modifications of foreign designs to suit local conditions in terms of manufacturing capabilities or intended uses;

c. Negotiations of contracts;

d. Training.

(ii) Non-electrical equipment industry: In this industry, which includes the manufacture of machine tools, agricultural equipment, factory equipment mining equipment, and automatic and semi-automatic bakery equipment, the domestic manpower made great efforts in the transfer of technology. It was able to modify foreign designs to suit the requirements of the Egyptian users, and contributed to the development of feeding industries such as forgings and castings. In addition, it initiated the use of computers in planning and management and established heat treatment facilities and ferrous metal research.

The existing capabilities encompass the following:

a. Selection of appropriate technologies;
b. Negotiation of contracts;
c. Modification of foreign designs, but not making new designs;
d. Planning and organizing;
e. Training.

(iii) Electrical equipment industry: In this industry, which includes the manufacture of medium motors, small and medium transformers, medium and low tension cables and distribution panels, the domestic manpower was able to absorb the foreign technologies. However, it has not been able to create local technologies except

in the case of the cable industry. In fact the Egyptian cable technology was transferred to the Libyan Arab Jamahiriya and to Saudi Arabia. The success of the Egyptian cable industry which achieved fantastic economic results, in spite of its relatively low selling prices, is attributed in part to its R and D efforts which enabled it to produce cables with the required quality and specifications at low cost.

(iv) Transport equipment industry: With respect to the manufacture of railway wagons, the domestic manpower was able to absorb and adapt the foreign technology. In fact it did design wagons up to a capacity of 200 tons, and sold the designs to Romania. In addition, the domestic manpower is engaged in planning, organization, and inspection activities. The industry has also developed its own technology for manufacturing second-class railway passenger wagons.

3.2.5. Institutional capabilities and interlinkages

The development of technological capabilities involves many interlinked elements, and its success depends not only on the effectiveness of those elements but also, and to a great extent, on the effectiveness of their interlinkages. The various elements are structured in a matrix whose rows represent the national level, sectoral level and implementation level. The columns represent the different economic sectors. The present status is described below:

(a) At the implementation level

Although the requirements for scientific and technological advancement in Egypt are available, few of the manufacturing establishments have units engaged mainly in developing the technological capabilities of the establishment. This situation can be attributed to the following reasons:

(i) The demand for the local products sometimes greatly exceeds the supply. Under this condition the manufacturing company does not feel the need to develop or modify its products.

(ii) Some companies seek fast returns on investment and thus keep away from R and D activities which pay off in the long run.

(iii) Many competent staff move out of R and D to production where opportunities for advancement are more available.

(iv) Researchers in universities and in research centres are more interested in academic rather than applied research.

In 1983 the Minister of Industry approved the setting up of an R and D unit in every establishment. Its functions include solving daily production problem interfacing with the industrial research centres which are engaged in the activities of its sector. The industrial research centres prepare the research plans. The General Organization for Industrialization (GOFI) and the Industrial Research Council at the Academy act as a link between the industrial sector and the research institution at the national level.

(b) At the ministerial or sectoral planning level

Up to the beginning of 1980, the planning units at the sectoral level did not distinguish between a technology contract and an equipment importation contract at the project level. Similarly they were not greatly concerned with depackaging technology and the analysis of its technical, economic and legal aspects.

GOFI concluded an agreement with UNIDO in 1979 for UNIDO assistance in establishing a unit concerned with evaluation and registration of technology transfer contracts. The unit was envisaged as the nucleus of a national centre. Because of the prevailing conditions at that time, GOFI chose to establish the unit as one of its own departments. Its functions include the following:

(i) To assist in developing and formulating a technology policy;

(ii) To obtain technological information from various sources and to act as a data bank. The department has become the representative of Egypt in the TIES system for exchanging information on technology contracts;

(iii) To advise the Egyptian negotiators before and during negotiations;

(iv) To act as a link between the industrial companies and the Academy for Scientific Research and Technology, the specialized research centres and the universities;

(v) To record the technology contracts, even those concluded before the unit was established;

(vi) To evaluate the technology contracts from the technical, economic, and legal aspects;

(vii) To follow up the implementation of the technology transfer contracts to identify problems and assist in solving them;

(viii) To study projects and their contracts.

(c) At the national level

There are many national institutions such as the Academy for Scientific Research and Technology, the National Centre for Research, specialized National Councils and specialized centres attached to the industrial sector or defence factories. However, their role is still limited. The reasons include the following:

(i) Research institutions are not well directed;

(ii) The flow of information between R and D institutions and manufacturing establishments is not efficient because of poor organization;

(iii) The directors of scientific research and technological development are isolated from the political decision makers;

(iv) Inadequate funds for technological development.

The Academy, GOFI, the Investment Agency and the State Council participated in preparing a proposal of a law for regulating the transfer of technology.

(d) Design offices and R and D centres

(i) The Centre for Development of Industrial and Engineering Designs: The centre was established in 1968 in co-operation with UNIDO. The objective was to develop product design capabilities and factory planning in addition to training R and D personnel producing prototypes. The centre has grown substantially. It now employs about 450 specialized and highly qualified staff. Its activities include:

- Design and development of various industrial products including consumer goods, transport equipment and machines;
- Design of capital goods and heavy engineering equipment;
- Design of production operations;
- Design and implementation of mechanical workshops, and factory planning;
- Heat treatment and mechanical testing;
- Assimilation of technological information through the ITAP project.
- Planning and implementation of training programmes for managers, engineers, technicians, inspectors, and skilled workers, in addition to specialized training programmes. The centre trains more than 1,000 persons per year.

(ii) The Alloys R and D Centre: The Centre was established by the efforts of the Academy for Scientific Research and Technology, the Ministry of Industry, GOFI and UNIDO to meet the needs of the metal fabrication and equipment manufacturing industries. The Centre encompasses many specializations including evaluation and refining of raw materials, extraction by electrometallurgical and hydrometallurgical methods and treatment of industrial waste. In addition, it has heat treatment and precision analysis facilities and mechanical workshops.

The main achievements of the Centre are:

- In evaluating raw materials and their concentration as well as extraction, the centre conducted studies on the Bahria Oases raw material project and phosphate and glass projects;

- To improve production, the Centre conducted research studies on galvanized steel, forgings, coke, etc;

- The Centre passed the results of its research studies on the production of transformer silicon steel, welding electrodes and others to the domestic companies;

- The Centre formulated and organized specialized training programmes on heat treatment, analysis methodology, etc. As many as 150 people are trained annually there;

- Creation of specialized research projects. One project was launched in 1983 to provide advice on how to economize in the use of energy in industry; it called for the training of 220 highly specialized industrial personnel. Another project concerned the establishment of an advanced welding unit to absorb the technology of welding to conduct applied research on future problems of welding and to organize training programmes.

The main reason for the success of the Centre is its close interlinkage with the production sectors. For that purpose the Centre devised many links including:

- The Technical Committee to supervise the Centre. The Committee is comprised of the chairmen of the boards of the companies concerned with the activities of the Centre. The Technical Committee establishes the research policy of the centre and meets twice every year. Its subcommittees meet monthly to review achievements;

- R and D committees within the companies which include personnel from production and R and D units as well as representatives from the Centre and the universities. The committees may also include certain experts in the fields of concern. The committees discuss the requirements of the company and assist it in the planning and implementation phases;

- The Industrial Research Council and the Metal Branch. The Centre and some concerned companies are members of the Metal Branch. As such they are active in issues of national concern;

- Organized visits between the Centre and the concerned industrial companies.

3.2.6. Exportation of Egyptian technology

Since the beginning of the 1970s, the Government has encouraged the research centres and the manufacturing establishments to co-operate with the Arab countries and to assist them in solving their technological problems.

Some examples of Egyptian and African co-operation in the transfer of technology in the field of capital goods are given below:

(a) The Centre for the Development of Industrial and Engineering Designs assisted Nigeria in establishing the African Centre for Engineering Designs.

The Centre assisted the United Republic of Tanzania in setting up the Industrial Development Centre. In addition, the Centre trained hundreds of engineers and technicians from Arab and African countries for periods ranging from five months to one year.

(b) The Nasr Automotive Manufacturing Company (NASCO) began its export activities in 1965 when it entered the Iraqi market and then the markets of Kuwait, the Libyan Arab Jamahiriya, the Syrian Arab Republic and the Sudan. The Company provides technological services by equipping the service and maintenance workshops and training the local staff to perform maintenance works and after-sales services. From 1973 to 1980 the company trained an average of 200 personnel from neighbouring countries.

(c) The Iron and Steel Company has been exporting its technology sometimes by means of contracts between the company and its counterparts in Arab and African countries, or between these companies and its staff. The countries concerned include the United Arab Emirates, Saudi Arabia, Kuwait, Bahrain, Qatar, Jordan, Iraq, Morocco, the Libyan Aran Jamahiriya and the Syria Arab Republic.

3.2.7. Technological infrastructure

(a) R and D units within the industrial establishments: in spite of the many decisions that were made to develop and organize these units, only a few have been able to make significant contributions to their establishment. Invariably, they suffer from shortage of research facilities and funds which in turn encourages many of their staff to seek better opportunities elsewhere.

(b) Specialized research centres: although many international organizations contributed to the establishments of these centres by extending financial assistance, offering the service of their experts or offering training grants, only a few were able to assume and maintain their role. One major reason has been the lack of confidence of the industrial establishments in the results of their research. Another reason has been the inability of these centres to undertake comprehensive research programmes because of shortage of funds, high turnover of staff, and weak interlinkages between them.

(c) Research centres within universities: although many specialized centres were established, the majority failed to make significant contributions to the industry. The following factors contributed to their ineffectiveness:

(i) The location of most of the centres in Cairo and Alexandria, away from factories;

(ii) The orientation of most of their research programmes towards the obstention of academic degrees and promotions and not towards solving technological problems;

(iii) The lack of availability of references and the shortage of research facilities and funds;

(iv) The brain drain;

(v) The inability to undertake a comprehensive research programme.

(d) Technological information centres: less than a handful of these centres exist. The largest is the patent office in the Academy of Scientific Research and Technology. Although the patent office has records of more than 7 million international and national patents, it is not properly organized. Most of the time it is easier to get information from the World Intellectual Property Organization in Geneva than from the Patent Office in Cairo.

(e) Consulting offices: although Egypt adopted a modern industrial planning and organization system at the end of the 1950s, it did not pay adequate attention to establishing and supporting consulting offices capable of studying, designing and supervising industrial projects. There have been two exceptions, namely:

(i) GOFI, which prepares industrial plans and, as an agent of Egyptian companies, concludes contracts with foreign sources of technology for the acquisition of technology and importation of equipment;

(ii) EGETALIC, which is an Egyptian Consulting Office established by four metal fabrication companies in co-operation with an Italian Consulting Office.

(f) Specialized Associations: although the few Associations that were formed particularly for foundry works, performed their duties satisfactorily more societies with different specializations are needed.

(g) Publications: although some research organizations used to publish and translate articles and books on science and technology, they stopped doing so because of economic constraints.

3.2.8. Assessment of technological capabilities

In this section the responses to the questionnaires which were submitted to manufacturing establishments are analysed in depth to determine quantitatively, whenever possible, the extent and level of each capability, from selection of technology all the way to marketing. The manufacturing establishments which are analysed include major capital goods manufacturers, namely:

- The El-Nasr Company for the Manufacture of Transformers and Electrical Products (ELMACO);
- The Egyptian Company for Metallic Construction (METALCO);
- The El-Nasr Automotive Company (NASCO);
- The Engineering Projects for Steel Works (STEELCO);

- The Egyptian Company for Railway Activities (SIMAF);

- The Boiler and Pressure Vessel Manufacturing Company;

- The Machine Tools Manufacturing Company.

From the above micro-approach a picture emerges for the whole country. Consequently, the status of capabilities at the macro-level becomes clear, as shown in the following paragraphs.

(a) El-Nasr Company for the Manufacture of Transformers and Electrical Products (ELMACO), (see annex I for details)

The Company manufactures distribution transformers, welding transformers, and breakers. The major planned projects in the next five years are the manufacture of condensors, insulators and galvanized steel towers.

ELMACO has been using the technology of France Transformer (F.T.) since 1983 under a licensing and know-how agreement which included assistance in developing new products and expanding current production, improving product quality, providing advisory service and training local staff. France Transformer has fulfilled the terms of the agreement. ELMACO did not give any information on possible constraints imposed by the agreement.

The Company has been able to assist the local suppliers of raw materials to improve their production to meet international specifications. In addition, it instituted better quality control methods.

ELMACO believes that the difficulties it encounters in obtaining the required technology stems from the multiplicity of laws, multiplicity of decision makers and shortage of funds. The Company propose direct contacts with the source of technology and more training in foreign factories.

The Company employed 847 people in 1983 as follows:

7	Top managers
68	Managers and section chiefs
16	Economists and accountants
1	Scientist
15	Electrical engineers
7	Mechanical engineers
1	Civil engineer
90	Technicians
79	Secretaries, trade school graduates
563	Unskilled workers.

The information supplied by the company is tabulated in table 36. It indicates the following:

- ELMACO has full capability for making pre-feasibility studies, performing after sales services, and marketing.

- It has, in conjunction with national organizations the capabilities for selection of technology and negotiation with foreign sources of technology.

- It completely relies on the local consultant/contractor for construction work, and similarly on Egyptian manufacturing companies for the spare parts it needs.

- It relies on national organizations, mainly GOFI and the Electricity Authority, and foreign partners, and its own capabilities in the area of feasibility study, engineering and factory design.

- For product design, process design, maintenance, R and D and training the Company relies on its own capabilities as well as those of foreign partners. According to the filled questionnaire, national organizations are not involved in these activities.

(b) The Egyptian Company for Metallic Construction (METALCO) (see annex I for details)

The main products of the Company are cranes, tanks, and metallic structures. The major planned activity for the Company in the next five years is a cutting unit utilizing computers. The size and composition of the work-force was not supplied by the Company.

The Company relies to a great extent on its own technology. However, for the manufacture of overhead cranes it depends on the technology of the Baynor Company of the Federal Republic of Germany which it gets according to a licence agreement. It also depends on the technology of the Ferrostahl Company of the Federal Republic of Germany for the manufacture of large metallic structures in accordance with a joint venture agreement.

The constraints imposed on METALCO by its utilization of foreign technologies are the following:

- METALCO cannot transfer the foreign technology which it acquires to other parties outside Egypt. Within Egypt it can do so with the prior consent of the foreign companies concerned.

- METALCO markets are already specified.

- METALCO must buy certain equipment to maintain product quality comparable to similar foreign products.

The major research achievements of the METALCO R and D unit are:

- Development of crane designs and use of computer aided design (CAD);

- Use of numerically controlled machines, and use of computer-aided manufacture (CAM) in welding and cutting operations.

Table 36. Technological capabilities of the El-Nasr Company for the Manufacture of Transformers and Electrical Products (ELMACO) in Egypt

	Company itself	National organizations		Foreign companies	
Source of technology	None			France Transformer F.T. (Licenser)	
Selection of technology	Yes	Egyptian Electricity Authority, GOFI, Ministry of Electricity			
Pre feasibility study	Yes 100%				
Feasibility study	Yes 20%	GOFI	50%	Foreign partner	30%
Engineering	Yes 20%	Research and Studies Dept. in the Egyptian Electricity Authority	70%	Foreign partner	10%
Factory design	Yes 20%	" "	70%	" "	10%
Construction	None	Dr. Jalal Momen office	100%		
Product design				Foreign partner	
Process design	Yes 20%			Foreign supplier of technology	80%
Maintenance	Yes 70%			Foreign supplies of equipment	30%
Mfg. of spare parts	None			Manufacturing Co.	100%
R and D	Yes 50%			Foreign supplies of technology	50%
After sales service (customer service)	Yes 100%				
Training Yes				Factory of foreign partner	
Marketing Yes 100%					

Source: Compiled by Joint ESCWA/UNIDO Industry Division.

With respect to the selection of suitable technology, the Company suffers from the fact that many government organs, GOFI, the Engineering Industries Agency and the Ministry of Industry participate in the process, which invariably lengthens the selection time.

As shown in table 37, the Company either by itself or in co-operation with national organizations, has most of the capabilities required in all phases of the project. Foreign companies are also involved in the following:

- Process design, maintenance and training;

- Selection of technology, feasibility study, product design and R and D (in the case of new projects).

In general, METALCO suffers from inadequate capabilities with respect to designing large industrial projects or total projects.

Table 37: Technological capabilities of the Egyptian Company for Metallic Construction (METALCO) in Egypt

	Company itself	National organizations	Foreign companies
Source of technology	Yes 100% except for new projects	None	Bayner Co. of the Federal Republic of Germany (manufacture of overhead cranes) Ferrostahl Company of the Federal Republic of Germany (manufacture of large metallic structures)
Selection of Technology	Yes	GOFI, Engineering Industries Agency, Ministry of Industry	
Pre-feasibility study	Yes 50%	GOFI, Engineering Industries Agency) 50%	
Feasibility study	Yes 30%	" " 70%	(Bayner Company Ferrostahl Company)
Engineering	Yes 100%	None	
Factory design	Yes 100%	None	
Construction	None	Local contractors 100%	
Product design	Yes 60%	Specialized design offices 40%	Suppliers of technology Bayner and and Ferrostahl Company (for new projects and expansion only)
Process design	Yes 80%		Suppliers of technology (Bayner and Ferrostahl 20 per cent)
Maintenance	Yes 90%		Suppliers of equipment 10 per cent
Mfg. of spare parts	Yes	Some local manufacturing companies	
R and D	Yes 60%	Specialized research centres 40%	Suppliers of technology (for new projects and expansion only)
After sales service (customer service)	Yes 100%	None	
Training	Yes	Universities, training centres, R and D centres	Manufacture of similar products
Marketing	Yes 100%	None	

Source: Compiled by the Joint ESCWA/UNIDO Industry Division.

(c) Nasr Automotive Company (NASCO) (see annex I for details)

NASCO manufactures trucks, buses, trailers, passenger cars, tractors and diesel engines. In the next five years the efforts of the company will be geared towards expanding the production of passenger cars and developing the production of trucks, buses and tractors.

The Company was able to overcome many difficulties it encountered relating to co-ordination with feeding industries, developing of maintenance facilities and training of staff. It was then able to absorb and adapt foreign technology.

The company used the following technologies:

- Klokner Humboldt Deutz (Federal Republic of Germany), 1959, trucks and buses.

- Fiat (Italy), 1961, passenger cars;

- IMR (Yugoslavia), 1961, agricultural tractors;

- Bolmot (Poland), 1971, passenger cars;

- Blombart (Federal Republic of Germany), 1961, trailers.

The modality used has been the licensing agreement with provision of supplying components in addition to technical assistance in various aspects of the project.

The constraints imposed by the licensing agreements are:

- The transfer of technology to other parties cannot be done without prior consent of the licenser.

- Locally manufactured products can be exported to specified areas. Outside of these areas, the consent of the licenser is required.

- Know-how and technology cannot be passed on to other parties.

- The licenser must approve the use of components and parts.

NASCO cites the multiplicity of laws and the long time spent in getting final approvals as the causes of its difficulties in getting the technology it needs. The Company makes the following specific suggestions to improve the state of technology:

- Establishment of an agency to regulate and control technology contracts;

- Stipulation in technology contracts that the licenser should assist in developing local feeding industries;

- Focus of a part of university research on industrial problems;

- Promotion of the use of CAD/CAM in industry;

- Formulation of incentive measures to curb the brain drain.

NASCO employed 11,273 people in 1983, as follows:

24	Top managers
479	Managers, (department and section heads)
2	Chemists
6	Scientists
1	Mathematician
194	Engineers
571	Economists and accountants
3876	Industrial technicians
531	Trade school graduates
560	Semi-skilled workers
5031	Unskilled workers

Table 38 indicates the following:

- NASCO has full capabilities in the areas of pre-feasibility studies and marketing.

- It relies on itself and on national organizations (specialized research centres, distribution and maintenance companies) in the area of R and D and after-sales services. As for construction, it relies completely on local consultants and contractors.

- NASCO and its foreign licenser are involved in factory design, product design, process design, maintenance and manufacture of spare parts. No national organizations are engaged in these activities.

- Feasibility studies, engineering, and training are activities in which the company, national organizations and foreign companies are involved.

(d) Engineering Projects for Steel Works (STEELCO) (see annex I for details)

The Company manufactures metallic and mechanical structures as well as bus bodies. In the next five years it plans to be involved in large structures and bridges. The Company did not reveal the size or structure of its work-force.

STEELCO uses the following technologies:

- Federal Republic of Germany: Demage, Kaltenback, Paddinghaw
- United Kingdom: Mubea

Table 38. Technological capabilities of NASR Automotive Company (NASCO) in Egypt

	Company itself	National organizations	Foreign companies
Source of technology			Deutz (Federal Republic of Germany) for trucks and buses, Polmot (Poland) for passenger cars, and IMR Yugoslavia) for tractors
Selection of technology	Yes	GOFI, Ministry of Industry	
Pre-feasibility study	Yes 100%		
Feasibility study	Yes	GOFI	Foreign licenser 50%
Engineering	Yes 20%	Consultants	Foreign licenser
Factory design	Yes 30%		Foreign licenser 70%
Construction	None	Local consultant and contractor 100%	
Product design	Yes 30%		Foreign licenser 70%
Process design	Yes 20%		Foreign licenser 80%
Maintenance	Yes 90%		Source of equipment 10%
Mfg. of spare parts	Yes		
R and D	Yes 70%	Specialized research centres 30%	
After sales service	Yes 40%	Distribution and maintenance companies 60%	
Training	Yes	Specialized centres	Foreign companies and specialized centres
Marketing	Yes 100%		

Source: Compiled by the Joint ESCWA/UNIDO Industry Division.

The restrictions imposed on the company include:

- Transfer of technology or proprietary material to a third party.
- Export of products to markets not specified originally without prior approval of licenser.

The technological capabilities relating to the activities of STEELCO are shown in Table 39 which indicates the following:

- The Company relies on its own capabilities completely in the areas of pre-feasibility study, engineering, factory design, R and D, after sales services and marketing.

- It relies on its own capabilities and those of national organizations for selection of technology, feasibility study, construction, product design and maintenance.

- As for process design and spare parts the Company relies on itself and on foreign companies.

- Training is an activity in which the Company and national and foreign companies are involved.

(e) The Egyptian Company for Railway Equipment (SIMAF), (see annex I for details)

The Company manufactures railway wagons for passengers and for transportation of goods and trams. It uses Japanese (Mitsubishi) and Hungarian (Ganzmafegy) technologies under licensing agreements. The Company has been able to absorb, adapt and transfer technology to some European countries.

The restrictions imposed by the licensing agreements include:

- Passing technology to other parties outside Egypt.
- Export of products to markets not within specified areas.
- Passing information to other parties especially competitors of the licenser.

- Import of certain components that cannot be manufactured locally.

The Company employed 1,150 people in 1983, as follows:

14	Top managers
227	managers and heads of sections
1	Scientist
1	Mathematician
26	Engineers
533	Industrial technicians
169	Trade school graduates
169	Unskilled workers

An examination of table 40 reveals the following:

Table 39. Technological capabilities of the Engineering Projects for Steel Works (STEELCO) in Egypt

	Company itself	National organizations	Foreign companies
Source of technology			Demag (Federal Republic of Germany) Kaltenbak (Federal Republic of Germany) Paddinghaw (Federal Republic of Germany) Mubea (United Kingdom)
Selection of Technology	Yes	GOFI, Engineers Industry Agency	
Pre-feasibility study	Yes 100%		
Feasibility study	Yes 50%	GOFI	
Engineering	Yes 100%		
Factory design	Yes 100%		
Construction	Yes	Local contractors	
Product design	Yes 60 %	Ministry of Electricity 40%	
Process design	Yes 90 %		Source of equipment in limited cases 10 %
Maintenance	Yes		
Mfg. of spare parts	Yes Limited		Foreign supplies of components & parts
R and D	Yes 100%		
After sales service	Yes 100%		
Training	Yes good	Specialized centres	Similar companies
Marketing	Yes 100%		

Source: Compiled by the Joint ESCWA/UNIDO Industry Division.

- The Company depends on its own capabilities in the areas of pre-feasibility study, product design, process design, maintenance, after-sales services and marketing.

- It relies on its own capabilities and those of national organizations in the areas of selection of technology, feasibility study, engineering, construction and R and D.

- Only in the case of factory design and training does the Company solicit the involvement of foreign companies in addition to its own and that of national organizations.

- It is clear from the above analysis that SIMAF has developed its technological capabilities to a higher level than most Egyptian companies considered in this study.

(f) The Boiler and Pressure Vessels Manufacturing Company (see annex I for details).

The Company manufactures steam boilers, heat exchangers and pressure vessels. In the next five years the Company, in co-operation with Stein Muller of the Federal Republic of Germany, plans to enter into the implementation of projects in electrical as well as food and chemical industries.

The Company uses technology from the Federal Republic of Germany (Stein Muller, Baumgart, and Babcock). It depends on these companies for training its personnel, strengthening its design capabilities and improving the quality of its products to meet the needs of its customers. The Company has licensing agreements with Stein Muller and Baumgart.

The restrictions imposed by the licensing agreements include the following:

- The Company must obtain the consent of the foreign partner to modify the design of products which carry both their names.

- The Company is allowed to export its products to markets not within the concern of the foreign partner. It can export production equipment of joint projects only after approval of the foreign partner. In addition, the transmission of any information to other parties is prohibited.

- The selling prices of locally manufactured products should not exceed those of the foreign partner.

- The foreign partner devises the training programmes and participates in the selection of trainees.

The Company indicated that many of its difficulties were caused by the multiplicity of laws and decision makers as well as the lengthy decision making processes. However, it did not offer any suggestions to rectify this situation.

Table 40. Technological capabilities of the Egyptian Company for Railway Equipment (SIMAF) in Egypt

	Company itself	National organization	Foreign companies
Source of technology			Mitsubishi (Japan), Gamzmafaz (Hungary)
Selection of technology	Yes	Railway Authority, Public Transport Authority in Cairo GOFI, Engineering Industry Agency	
Pre-feasibility study	Yes 100%		
Feasibility study	Yes 60%	GOFI, Railway Authority 40%	
Engineering	Yes 20%	Various consultants 80%	
Factory design	Yes 80%	Local consultants	Foreign companies
Construction	Yes 20%	Various contractors 80 %	
Product design	Yes 100%		
Process design	Yes 100%		
Maintenance	Yes 100%		
Mfg. of spare parts	Yes		
R and D	Yes 50%	Academy of Scientific Research and Technology 50%	
After sales service	Yes 100%		
Training	Yes good	Specialized centres	Specialized centres and manufacturing companies
Marketing	Yes 100%		

Source: Compiled by the Joint ESCWA/UNIDO Industry Division.

The Company employs 938 people as follows:

3	Executive managers
204	Managers and heads of sections
10	Statisticians
1	Scientist
7	Electrical engineers
42	Mechanical engineers (production)
4	Electronic engineers
2	Chemical engineers
26	Economists and accountants
273	Skilled and semi-skilled workers
366	Unskilled workers.

An examination of table 41 reveals the following information on technological capabilities:

- The Company completely depends on its own capabilities in regard to pre-feasibility studies and marketing.

- The Company does not have capabilities in engineering, factory design and construction, but relies on the capabilities of GOFI and foreign companies.

- The Company relies on its own capabilities and those of national organizations in regard to selection of technology and negotiations and feasibility studies.

- In the areas of product design, manufacture of spare parts, R and D, and training, the Company relies on its capabilities as well as those of national organizations and foreign companies.

- The Company relies on its capabilities and those of foreign companies with respect to process design, maintenance and after-sales services. No national organizations are engaged in these activities.

(g) Machine Tools Manufacturing Company, (see annex I for details)

The Company manufactures machine tools and automatic bakery equipment. It plans to expand in the next five years into the manufacture of flour mills equipment, construction equipment and building material, textile equipment and mechanized agricultural machinery.

The Company employed 2,163 people in 1983, as follows:

6	Top managers
84	Managers and heads of sections
1	Mathematician
6	Electrical engineers
28	Mechanical engineers
3	Electronic engineers
2	Production engineers
1,672	Industrial technicians
248	Trade school graduate
113	Others

Table 41. Technological capabilities of the Boiler and Pressure Vessels Manufacturing Company in Egypt

	Company itself	National organization	Foreign companies
Source of technology	None		Federal Republic of Germany, Stein Muller, Baumgart, Babcock
Selection of Technology	Yes	GOFI, Engineering Industries Agency, Ministry of Industry	
Pre-feasibility study	Yes 100%		
Feasibility study	Yes 40%	GOFI, Engineering Industries Agency, Ministry of Industry 60%	
Engineering	None	GOFI, Engineering Industries Agency, Ministry of Industry 30%	Foreign partner 70%
Factory design	None	GOFI, Engineering Industries Agency, Ministry of Industry 30%	Babcock the of Federal Republic of Germany, Baumgart of the Federal Republic of Germany, Briant of India 70%
Construction	None	GOFI, Engineering Industries Agency, Ministry of Industry 30%	Foreign consultant 70%
Product design	Yes 20%	College of Engineers at Cairo University 20%	Stein Muller, Baumgart of the Federal Republic of Germany 60%
Process design	Yes 60%		Baumgart of the Federal Republic of Germany 40%
Maintenance	Yes 70%		Foreign partner (Stein Muller) 30%
Mfg. of spare parts	Yes	Manufacturing companies	Foreign sources for importation of spare parts
R and D	Yes 20%	College of Engineers at Cairo University 25%	Foreign partner (Stein Muller) 50%
After sales service (customer service)	Yes 60%		Foreign partner (Stein Muller) 40%
Training	Yes	Universities, training centres, research centres	Foreign partners and specialized centre
Marketing	Yes 100%		

Source: Compiled by the Joint ESCWA/UNIDO Industry Division.

It utilized Russian technology (Brumas Export) and Federal Republic of Germany technology (Fiyer, Fawler and Filder). The modality used is licensing with provisions made to supply certain components, improve production and train personnel.

The foreign companies impose restrictions on the Machine Tools Manufacturing Company with regard to the following:

- With respect to transfer of technology to a third party outside Egypt;

- With respect to passing proprietary information to a third party;

- With respect to export within specified Arab and African markets, which is permitted, while export to other markets requires prior approval by the foreign partner;

- With respect to certain components to ensure that quality is maintained.

The Company indicates that its main problems are:

- The multiplicity of laws affecting the transfer of technology;

- The long time span needed to get necessary decisions and approvals;

- Convincing customers of the merits of the adopted technology, especially with respect to equipment and machines not within the machine tools category;

- Lack of national organizations which can assist the Company in absorbing foreign technologies within a reasonable time;

- Delays in construction works by local contractors.

An examination of table 42 indicates the following:

- The Company relies exclusively on its capabilities in the areas of pre-feasibility study and after-sales services.

- The Company relies exclusively on local consultants and contractors for engineering and construction work.

- The Company relies on its own capabilities and those of concerned national organizations, mainly GOFI, for feasibility study.

- The Company depends on its own capabilities and those of foreign companies for factory design, product design, process design, maintenance and manufacture of spare parts. National organizations do not play any role in these activities.

- The Company utilizes all capabilities: in-house, national and foreign, for R and D and training.

Based on the analysis undertaken in this section,it is possible to describe the status of technological capabilities in Egypt as follows:

(i) Source of technology: The capital goods industry in Egypt relies almost exclusively on foreign technologies. Out of the seven major capital goods companies analysed in this study, only one company - the Egyptian Company for Metallic Construction (METALCO) - relies to a great extent on its own technology. Nevertheless METALCO depends on foreign technology (Bayner and Ferrostahl of Federal Republic of Germany) when it comes to overhead cranes or large metallic structures.

(ii) Selection of technology: The process of evaluating technology alternatives and the selection of the appropriate technology is an activity which is undertaken completely on a local basis, i.e. by means of the company concerned and certain national organizations. The main national organizations are:

- The Egyptian Electricity Authority Ministry of Electricity GOFI	In the case of transformers and electrical products
- Engineering Industry Agency Ministry of Industry GOFI	In the case of metallic structures
- Military Industries Authority Ministry of Industry GOFI	In the case of: automotive products
- Engineering Industries Agency GOFI	In the case of steel structures
- Railway Authority Public Transport Authority Engineering Industries Agency GOFI	In the case of railway wagons
- Ministry of Industry Engineering Industries Agency GOFI	In the case of boilers and pressure vessels
- Military Industries Authority GOFI	In the case of machine tools

It is clear from the above that the General Organization for Industrialization (GOFI) is always involved in the selection of technology in the capital goods industry. It is followed by the Engineering Industries Agencies (GAFI).

Table 42. Technological capabilities of the Machine Tools Manufacturing Company in Egypt

	Company itself	National organization	Foreign companies
Source of technology	None		Bromass Export (the Soviet Union), Foyer (Federal Republic of Germany), Fawner and Filder (Federal Republic of Germany)
Selection of Technology	Yes	GOFI, Military Industries Authority	
Pre-feasibility study	Yes 100%		
Feasibility study	Yes 60%	GOFI, Military Industries Authority 40%	
Engineering	None	Local consultants 100%	
Factory design	Yes		Source of technology
Construction	None	Local contractors 100%	
Product design	Yes 60%		Source of technology company 40%
Process design	Yes 70%		Source of technology company 30%
Maintenance	Yes 90%		Source of equipment 10%
Mfg. of spare parts	Yes		
R and D	Yes 90%	Local research centres and university (Ain Shams and Helwan universities)	Source of technology company 10%
After sales service (customer service)	Yes 100%		(Stein Muller) 60%
Training	Yes	Specialized centres	Foreign company
Marketing	Yes 80%		Source of technology company 20%

Source: Compiled by the Joint ESCWA/UNIDO Industry Division.

(iii) Project inception and identification: Over the years a series of development plans has been established and projects which were useful to the national economy were identified. The ability to do this is certainly within the national capabilities. GOFI is the main responsible body, but GAFI also prepares listings of projects open to joint ventures.

(iv) Pre-feasibility study: Egypt possesses strong capabilities to conduct these studies. In the majority of cases the companies themselves possess these capabilities. Only in the case of METALCO do national organizations, namely GOFI and GAFI, participate in this activity.

(v) Feasibility study: The companies participate in this activity together with national organizations and sometimes with foreign partners. The major national organizations are:

- GOFI in the case of transformers, etc.
- GOFI and GAFI in the case of metallic structures.
- GOFI, Armed Forces and Ministry of Industry in the case of automotive equipment.
- GOFI in the case of steel structures.
- GOFI and the Railway Authority in the case of railway wagons.
- GOFI in the case of boilers and pressure vessels.
- GOFI and Military Industries Authority in the case of machine tools.

It is clear from the above that GOFI has strong capabilities in the area of feasibility studies. Of course the fact that the companies do not rely exclusively on their own capabilities to perform such studies should not reflect negatively on their performance. On the contrary this indicates an efficient utilization of manpower on the part of the companies as well as good co-ordination between the companies and national organizations concerned.

Thus, there is a strong national capability in the Government sector to undertake these studies for large projects. However, a large number of these studies are given to expatriate consultant firms specialized in industries. The main reason has been the fact that many foreign countries have granted favourable financial terms for such studies as well as grants, thus dampening national efforts in this area. In the case of the private sector numerous consultants as well as the EIDDC Small Industries Programme provide such services.

(vi) Engineering and factory design

Power, light, facilities, water and sewage are available, along with the architectural work, except in very specialized cases. However, the plant engineering associated with the industry type

is sadly lacking. EIDDC has operated extensively in this area, but local consultants have failed to operate because work was not given to them due to client bias towards the foreign manufacturer's engineering. Of course, in some special cases it becomes necessary to involve the foreign partner in this activity.

The national organizations involved in this activity are the following:

- Research and Studies Department in the Ministry of Electricity in the case of transformers.

- Local consultants in the case of automotive equipment, railway wagons, and machine tools.

- GOFI in the case of boilers and pressure vessels.

(vii) Construction: This is fully covered by local capabilities (contractors). Only in very specific cases are construction data dependent on machinery and equipment used by the local contractors. The open door policy, however, has allowed expatriate contractors into the country on some projects. Though this was considered very undesirable before the open door policy, it is sometimes now looked upon as an incentive to local construction to improve and compete and allow new construction methods and technologies into the country.

(viii) Product and process design: Here again, especially in process design, there seems to be limited progress though more and more projects have their processes determined by local expertise. However, the licenser appears to be totally in charge, with local consultation. A good example of local input is the case of ENPPI, which now determines process design for petroleum projects and takes the initiative with outside suppliers. Product design has been easier. It can be said that most engineering industries, as consumer white goods in the private sector, have their own product design efforts.

EIDDC assists nearly 150 producers in designing, redesigning or adapting the products annually. A large variety of engineering products have come on the market.

Drawing offices exist in the smaller enterprises, but design offices exist in the larger public sector companies.

In the case of the joint venture companies, product design is left to the foreign partner in order to keep up with world developments. This concept has been increasingly adopted with the open door policy. Significant examples are washing machines (fully automatic), refrigerators (large capacity) and automobiles.

Local product design is evident in simple washing machines, small refrigerators, trailers for fast haulage, cement-brick-making machines, simple machine tools and wood-working machinery.

An examination of the companies under analysis indicates that with regard to process design, national organizations do not play any role. This activity is left to the company and the foreign partner. Percentage-wise, the foreign partner provides the large part of the effort. An exception to this is the case of the Egyptian Company for Railway Equipment (SIMAF) which relies exclusively on its own capability. This leads to another observation, namely that the capital goods industry has not performed satisfactorily in the area of process design. It seems that by now all companies should have mastered this activity except of course in new projects which necessitate involvement of the foreign partner.

(ix) Maintenance: With the exception of SIMAF, all companies analysed in this paper rely partly on their own capabilities and partly on foreign suppliers of equipment in the area of maintenance. The relative dependence of Egyptian companies on the foreign suppliers of equipment is shown below.

The participation of foreign suppliers of equipment in maintaining the equipment they sell is a normal activity. However, in the case of electrical products and boilers, the local companies should strengthen their capabilities. Another observation pertains to the lack of national organizations involved in the area of maintenance. It is believed that this is an important step to take, possibly in conjunction with building up capabilities to manufacture spare parts.

(x) Manufacture of spare parts: All analysis of companies indicates that they manufacture some spare parts for their production machines and equipment. No more clarification has been given. However, it seems that this activity is limited in scope. The companies should be in a position to make their own spare parts or at least procure them from a national organization except in very special cases when they have to be bought from foreign suppliers of equipment. The manufacture of spare parts at the national level can be combined with maintenance in one national organization.

(xi) Production and management

Without any doubt, this area is fully covered by local capabilities. Egyptian managers are well trained in industry by numerous training organizations such as: the American University in Cairo (AUC), Sadat Academy and EIDDC as well as some private training organizations such as the Transport, Engineering and Management Centre (TEAM) and others. They have extensive practical experience and are also trained abroad in industry.

(xii) Quality control

Quality control systems exist in all companies with varying degrees of sophistication. However, it can be said that all the aspects of quality control are known. Standards exist, a standardization organization is active, and systems are introduced and implemented.

Many courses are also held for quality control at AUC, EIDDC which help to develop the management and theoretical aspects of quality.

(xiii) Research and development

A great deal of basic research goes on at the universities, the NRC and the research centres of the various ministries. More practical research is evident in many industrial companies. The Academy of Scientific Research and Technology, through its industry committee and specialized subcommittees, has adopted numerous research projects in connection with industry. Such projects deal with improvements of special steels, uses of natural gas in vehicles, CAD/CAM in mechanical engineering, welding technology, etc.

The scientific community in Egypt encompasses almost all specializations.

Efforts are continuously being made to narrow the traditional gap between scientific research and industry needs, with considerable success.

Examining the companies under analysis more closely reveals that this capability is possessed by the companies themselves and provided also by national organizations and foreign companies. STEELCO for example depends fully on its own resources. SIMAF depends on itself and on the Academy of Scientific Research and Technology. The other companies also rely, in addition to their resources, on national organizations, specialized research centres in the case of METALCO and NASCO, and universities in the case of Boilers and Machine Tools. In general, it seems that R and D should be strengthened at the plant level and that linkages with other possible organizations concerned with R and D such as universities and specialized research centres should also be strengthened . Of course there need be no contradiction or duplication between R and D within the plant and R and D within universities or specialized research centres. R and D within the plants is of a more direct and urgent nature than R and D outside the plant.

(xiv) After-sales services: NASCO relies on its own resources (40 per cent) and those of national distribution and maintenance organizations (60 per cent) in conducting after-sales services. As for boilers and pressure vessels, the Company in question relies on its own capabilities (60 per cent) and those of a foreign company, Stein Muller (40 per cent). The complexity of steam boilers and other chemical equipment explains the need to engage a specialized reputable foreign company in this activity. The rest of the companies rely exclusively on their own capabilities.

(xv) Training: all the companies analysed in this study revealed that they undertake the training function very seriously at all levels:

- On-the-job
- At specialized national organizations such as training centres and universities
- Abroad, at the facilities of the source of technology.

Table 43. Technological capabilities in the Egyptian capital goods industry

	ELMACO	METALCO	NASCO	STEELCO	SIMAF	NASR BOILER	MACHINE TOOLS Mfg Co.
Source of technology	F	C F	F	F	F	F	F
Selection of technology	CN	CN	CN	CN	CN	CN	CN
Pre-feasibility study	C	CN	C	C	C	C	C
Feasibility study	CN F	CN F	CN F	CN	CN	CN	CN
Engineering	CN F	C	CN F	C	CN	N F	N
Factory design	CN F	C	C F	C	CN F	N F	C F
Construction	N	N	N	CN	CN	N F	N
Product design	C F	CN F	C F	CN	C	CN F	C F
Process design	C F	C F	C F	C F	C	C F	C F
Maintenance	C F	C F	C F	CN	C	C F	C F
Mfg. of spare parts	N F	CN F	C F	C F	C F	CN F	C F
R and D	C F	CN F	CN	C	CN	CN F	CN F
After-sales service	C	C	CN	C	C	C F	C
Training	C F	CN F	CN F	CN F	CN F	CN F	CN F
Marketing	C	C	C	C	C	C	C F

Source: Compiled by the Joint ESCWA/UNIDO Industry Division.

Note: C = capability within the company.
N = capability within a national organization.
F = capability provided by a foreign company.

(xvi) Marketing: except for the Machine Tools Co., which engages its foreign counterpart (20 per cent of total effort) for marketing, all other companies possess this capability in-house.

A summary of the above assessment is shown in table 43.

3.3 Jordan

3.3.1 General state of technology

The economic and social development which has taken place in Jordan over the past 25 years created a national awareness of the need to strengthen the science and technology base in the country. The major steps made towards this goal included the following:

- Setting up the Royal Scientific Society (RSS) in 1970 to carry out R and D work and to provide scientific and technical services;

- Setting up the Science and Technology Department in the Ministry of Planning in 1980 to co-ordinate and promote scientific and technological activities at the national level and to assist in the formulation of national science and technology policies and plans. The Department is mandated to revise existing laws and measures pertaining to science and technology activities in order to ensure adequate support for such activities and to regulate matters related to the transfer of technology. The Department was supposed to be assisted by a national Supreme Committee of Science and Technology which was established for that purpose although it has not met for the last five years;

- Levying of a limited tax to support work in the field of science and technology at Jordan's universities;

- The current Five-Year Plan called for a co-ordinated programme of R and D aimed at solving the industrial and agricultural problems facing Jordan. The plan proposed the allocation of not less than 1 per cent of GNP to finance R and D activities.

3.3.2 Technology in industry

Most of the new technologies (in the restricted sense of equipment technology) in Jordan are transferred from abroad in the form of imports. Thus the nature and efficiency of the transfer process is a matter of importance in view of the continued rapid expansion of the economy.

The pattern of techniques available in industry are in most cases of the "conventional" type, i.e., the technology is regarded as "standard" practice involving the use of semi-automatic systems at sub-process level. The next largest group of industries uses "basic" technology, i.e., the technology that is dominated by a mixture of semi-automatic and non-automatic equipment and which is found in the older generations of factories in the

industrialized countries. Very few firms use the "highest" or "lowest" technologies, whereas users of traditional technology figure more prominently, in rural areas, in small workshops, and in one-man operations. Over the next five years it seems likely that much of the industrial expansion will be in the conventional technological industries, producing standard consumer goods and simple capital goods, the production technology of which is stable and widely known.

The recent inward transfers of technology have taken the form of modern and fairly capital-intensive plants and machinery. In most cases, they were made by various mechanisms, including straightforward purchases, licensing, turnkey arrangements, and consultant services. Other mechanisms such as franchising, managerial contracts, multinational packages and leasing of equipment, are not very common in Jordan,. Licensing is heavily concentrated on the chemical and petroleum products industries. In all cases, the key element in the transfer is the purchase of plant and machinery. Only in rare cases do firms seek assistance in management methods. In the majority of cases, the assistance is sought for the design and manufacture of the product, and for quality control rather than for management and product technology. In some cases, the Jordanian proprietors buy a "black box", and exercise no influence over the nature of the technology installed. This could create serious problems. However, there is some evidence that long-established firms have matured and their home-grown technical and managerial expertise has developed sufficiently to enable them to exercise greater autonomy in the selection of technology and the mechanism for its transfer.

The difficulties experienced with operating and maintaining production equipment are partly due to their complexity in relation to available manpower. The lack of independent R and D capabilities is also important in this context. Problems arising due to these factors include the underutilization of machinery.

The rapid growth of vocational education and other educational institutions in addition to the increasing numbers of returning skilled workers from abroad indicate that there are prospects for a large surplus of skilled workers and intermediate level workers in the industrial sector. In the higher education sector, the number of qualified personnel is substantial. It indicates that the supply of scientists and technologists will be sufficient to satisfy the needs of the mining and manufacturing sectors.

On the other hand, given the level of economic development and market size of Jordan, it is unlikely that a manufacturing industry producing a wide range of high technology equipment will emerge in the foreseeable future. As a consequence, so long as firms demand sophisticated production technology, Jordan will remain dependent on foreign suppliers for most of its plant and equipment. Less sophisticated machinery is, in general, produced using less sophisticated and relatively labour-intensive techniques. So any move away from the use of "high" manufacturing technology in industry would increase the likelihood that local suppliers of production machinery could establish themselves with obvious benefits. No particular problems are normally faced by firms in gaining access to information on technological possibilities and

resources or in acquiring needed plant and machinery. However, until indigenous skills and technologies are strengthened, Jordan will be unable to reap the full benefits of "spin-offs" available from the continued inward transfer of technology.

3.3.3 Research and development

Jordan generates very little of its own technology. The lack of adequate facilities, finance and technical expertise might account for that. A very limited amount of resources and personnel is devoted to in-house R and D activity in Jordanian firms. According to the 1982 survey, the total expenditure in R and D amounts to about 0.5 per cent of the country's GNP. Of this expenditure, only about 10-15 per cent is spent in the production sector. Even then, R and D is primarily concerned with fairly minor adaptations of existing products and processes.

As regarding R and D strategy, it is clear that the benefits to be derived from expanding R and D programmes must be compared with the gains to be derived. Any such calculations involve a large speculative element, but it does seem clear that, on the one hand, the lack of an R and D capability has not crippled industrial expansion though it may have distorted its pattern. On the other hand, a very considerable outlay on R and D would be necessary to generate worthwhile benefits for the majority of firms, given that Jordanian industrial output is scattered widely over a range of industries. For the time being, there seems to be little prospect that the private sector will finance R and D work. The same need not be true, however, for the public sector.

(a) The Royal Scientific Society (RSS) in Jordan performs a number of scientific and technical functions which are clearly relevant to the process of economic development. Such functions include technical trouble-shooting, testing services and devising and checking quality "Standards" for the output of the industry. Beyond this, RSS has been involved in various research activities such as harnessing solar energy and commercial development of desalination and power generation technology.

RSS also has considerable expertise in production engineering and a number of innovations have been developed into prototypes which can be sold to the public (e.g., solar heaters). Consideration might also be given to the possibility of injecting the RSS expertise and know-how directly into the production sector by seconding staff to industry or by assisting them to set up their own enterprises. This process applies also to Jordanian universities and is being followed to maintain the research and development momentum of these institutions.

The Society was established as a research centre in Amman in 1969. It is organized in 9 departments as follows:

- Information and budget (46 staff)
- Administration affairs (35 staff)
- Mechanical engineering (68 staff)

- Industrial chemistry (40 staff)
- Building research centre (86 staff)
- Electronic service and training centre (45 staff)
- Computer systems (42 staff)
- Economics (35 staff)

In 1983 the number of university graduates was 197 including 104 scientists and 93 engineers: 115 had Bachelors degrees, 43 Masters and 39 Doctorate degrees.

The Society considers itself a regional institute on industrial research and is involved in many sectors including the capital goods and engineering industries. Its activities include:

- Technical services
- Quality control
- Standards
- Information service
- Product development and evaluation
- Applied research
- Feasibility studies and surveys
- Material testing.

The efforts of RSS are distributed among the following fields:

- Basic research 65 per cent
- Testing 15 per cent
- Applied research 20 per cent

The Society conducts training programmes:

- In-house : in industrial and mechanical engineering
- In the country : in computer science and solar energy
- In the region : in electronics and building research.

The Society believes that financial constraints hinder its role, and that governmental support to the general policy of science and technology will enhance it.

Part of the budget of RSS is derived from services rendered by it. An example of this is the solar water heater which was developed by RSS and then sold to others to manufacture it commercially.

(b) Yarmouk University: was established in 1976 in Irbid, Jordan. In the period 1985-1987 it had an enrolment of 13,753 undergraduate and 672 graduate students. Of these, 1,181 studied business administration, 1,075 studied economics, 3,245 studied science, 1,504 studied engineering and 190 were in architecture. The languages of instruction are Arabic and English.

The teaching staff totalled 505:

- 367 Jordanians
- 38 Arabs
- 100 Foreigners

The curricula and enrolment are decided upon on the basis of the needs of the development plans of Jordan.

The university has not undertaken R and D projects during the last three years either for its own purposes or for industry. However, it plans to undertake projects on microprocessor controlled systems, microcomputer design, CAD and CAM.

Yarmouk University maintains co-operative graduate programmes with foreign universities such as the University of Paris. Unfortunately, information on this subject was not available from the University of Jordan in Amman.

In summary, because Jordan's capital goods and engineering industries are rather limited it has not been pressed to develop its technological capabilities. Its hope lies in regional or subregional industrialization.

3.4 Morocco

3.4.1 Criteria for the selection of technology

The factors affecting the acquisition and mastering of the technology in Morocco are related to different stages of project implementation, which are:

- Pre-feasibility and feasibility studies
- Engineering design and construction
- Technical assistance training and management.

The transfer of the technology process can be labelled successful when, at the end of the licensing period, products are manufactured according to the specified standard, at a reasonable cost, and the technology is fully mastered. A good test criterion would be if new products could be developed independently, based on the acquired technology.

The problems encountered in this process in Morocco can be identified and depend on the following factors:

- Choice of products to be manufactured;

- Choice of technology and machinery. The question here is whether the production is simply an assembly operation or not, and whether it consists of an integrated production process. The degree of flexibility and sophistication is also important in this respect.

- Choice of foreign technical partner. This can mean a choice between a production process with high value added or one based on a relatively low-priced licence fee.

- Standardization and quality of manufactured products. The establishment of a central laboratory for quality control standards is at present under study.

- Absence of a reglemented procedure for the transfer of technology. Except for the automobile manufacturing sector, the investment in the capital goods sector is unrestricted. The only restriction concerns the transfer of foreign currency. Furthermore, there is no industrial register for the transfer of technology agreements.

In many instances, the above-mentioned problem areas lead to problems in the production process and this negatively influences the total production capacity of the country and the development of national capabilities and technologies.

3.4.2 Modalities for transfer of technology

In the following paragraphs a number of industrial establishments are described as examples for the import of foreign technology, the modalities of its transfer and its present status (see also tables 44 to 46).

(a) The General Electrical Company (GEC) - Maroc

The technology used in this company is provided under a licence agreement with the French Company CGE, which provides design, machinery, studies and expertise. The Company relies to a great extent on foreign expertise, and possesses all the technological capabilities, except construction. It has no close links with the universities or R and D centres in the country but it has in-house training facilities to upgrade the skills of its staff.

Table 44. Technological Capabilities of GEC - Morocco

Technological capabilities	Company itself	National organization	Foreign companies
Source of technology			CGE - France
Selection of technology		National Exchange Office	CGE - France
Pre-feasibility study	Yes		Yes France
Feasibility study	Yes		Yes France
Engineering	Yes		Yes France

Table 44. (Continued)

Technological capabilities	Company itself	National organization	Foreign companies
Factory design	Yes		Yes France
Construction		Yes	
Product design	Yes		Yes France
Process design	Yes		Yes France
Maintenance	Yes		Yes France
Manufacturing of spare parts	Yes		Yes France
R and D	Yes		Yes France
After-sales service	Yes		Yes France
Training	Yes		Yes France
Marketing	Yes		Yes France

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources

(b) Berliet - Maroc. Assembly of trucks and buses

The Company has no direct links with the universities or R and D centres, but there is a training programme in-house, as well as at the parent company, in diesel maintenance, assembly and plant management.

The Company has a studies department, which can independently undertake studies, e.g. the Company has undertaken techno-economic studies for the establishment of a complex for the manufacture of diesel engines. However, owing to the present economic conditions, this project has been postponed.

The Industrial Development Office (IDO), which falls under the Ministry of Trade and Industry, is the organization that provides assistance in the selection of foreign technology. The Company itself has limited capabilities in pre-feasibility studies, product and process design, marketing, maintenance and after sales service. It still relies on R.V.T. for product and process design. It still lacks skilled Moroccan labour and therefore continues to rely on its foreign partner.

Table 45. Technological capabilities of Berliet - Morocco

Technological capabilities	Company itself	National organization	Foreign companies
Source of technology			France (R.V.I)
Selection of technology		Yes, Industrial Development Office	
Pre-feasibility study	Yes		
Feasibility study		Yes, Industrial Development Office	
Engineering		Yes	
Factory design		Yes	
Construction		Yes	
Product design	Yes		Yes (R.V.I)
Process design	Yes		Yes (R.V.I)
Maintenance	Yes		
Manufacturing of spare parts	Yes		
R and D			
After-sales service	Yes		
Training	Yes		Yes
Marketing	Yes		

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

(c) The Mechanical and Electrical Industries Company (SIMEF)

The Company reports that it does not depend on foreign expertise for its normal operations, although problems are encountered in production management, caused by the difficult economic situation in the country since 1978, and the implementation of technology transfer agreements concluded with foreign manufacturers.

Table 46. Technological Capabilities of the Mechanical and Electrical Industries Company (SIMEF) in Morocco

Technological capabilities	Company itself	National organization	Foreign companies
Source of technology			Leroy Somer-France) (Petter - England)
Selection of technology		Industrial Development Office	
Pre-feasibility study	Yes		
Feasibility study	Yes		
Engineering	Yes		
Factory design	Yes		
Construction		Yes	
Product design	Yes		
Process design	Yes		
Maintenance	Yes		
Manufacturing of spare parts	Yes		
R and D	Yes		
After-sales service	Yes		
Training	Yes	Yes	Yes
Marketing	Yes		

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

3.4.3 Institutional capabilities

An example of a Moroccan consultancy company active in the capital goods sector can be found in the Moroccan Company for Engineering and Technological Projects (MAROTEC).

Its activities include, the study for and execution of, industrial projects and civil engineering. For example, in the last five years it has undertaken the following projects:

- Study for a 5 million tons per annum phosphoric acid complex, with an investment cost of $US 400 million;

- Feasibility study for and supervision of the construction of a project for transforming an oil-fired cement plant into a coal-fired one;

- Study and implementation of a project for the storage and mixing of phosphoric acid with a chemical compound.

- Detailed engineering study for a fertilizer production project.

Some of the above studies were undertaken in co-operation with the French company "Technip".

The Company is a joint venture with Spie Batignoles, which has a 35 per cent share.

The Company's dependence on foreign expertise is due to the lack of comprehensive experience in particular projects, such as chemical production processes. It has, however, capabilities in the engineering and design of other industrial projects, as shown above.

Its staff are capable of carrying out the following specialized functions, to a large degree independent of outside expertise:

- Process engineering
- Civil engineering
- Plant lay-out
- Metal structures
- Air-conditioning
- Low/medium voltage power generation
- Design of industrial pipework (in both metal and plastic)
- Hydraulic engineering
- Pre-feasibility studies
- Project investment analysis
- Planning, construction and supervision of industrial projects.

These capabilities have been built up during the Company's existence by gradually replacing foreigners with skilled nationals. For this purpose, the Company has in-house training programmes and it also sends its employees abroad for study.

The partner in the joint venture assists MAROTEC in further developing its staff under this agreement. In the future, MAROTEC hopes to be able to export its expertise to other Arab countries, especially in the fields of chemical and fertilizer industries, water desalination projects and design and construction of tourist facilities.

3.4.4 Assessment of technological capabilities

The structure of the metal working, engineering and electrical industries in Morocco are reasonably diversified and performing well, although there is a great lack of basic industries such as iron and steel plants and foundries, which reflect a low-level self-sufficiency, approximately 10 per cent.

This situation severely hampers the downstream development of the capital goods industries.

Furthermore, most of the transfer of technology is in the form of licence agreements and/or technical assistance, which involve limitations and restrictions in such a way that the local partner does not derive to the fullest extent the benefits of the technology transfer process. No regulation or control is exercised by government authorities, and therefore no consideration is given to the needs of the sector in terms of appropriate technology, and how to reach independence in the technological field.

In many instances, the above-mentioned problem areas lead to problems in the production process and this negatively influences the total production capacity of the country and the development of national capabilities and technologies.

Thus there is often a general lack of capabilities for undertaking feasibility studies, engineering design work and production management. This has led to a reliance on a combination of the following methods in the transfer of technology:

- Foreign expertise
- Agreements for the supply of equipment
- License agreements
- Specific technical assistance provided at different stages of the project.

This combination often takes the form of a "technological package", consisting of all four elements, as could be seen in the above-mentioned examples. Most of these companies have now built up extensive expertise in the production process, without, however, being able to undertake independently the necessary engineering design work for new activities.

The above assessment is shown in table 47 below.

Table 47: Technological capabilities in the Moroccan capital goods industry

Capabilities / Company	CGE	BERLIET	SIMEF
Source of technology	F	F	F
Selection of technology	NF	N	N
Pre-feasibility study	CF	C	C
Feasibility study	CF	N	C
Engineering	CF	N	C
Factory design	CF	N	C
Construction	N	N	N
Product design	CF	CF	C
Process design	CF	CF	C
Maintenance	CF	C	C
Mfg. of spare parts	CF	C	C

Table 47: Continued

Capabilities			
Company	CGE	BERLIET	SIMEF
R and D	CF		C
After-sales service	CF	C	C
Training	CF	CF	CNF
Marketing	CF	C	C

Source: Compiled by Joint ESCWA/UNIDO Industry Division.
Note: C = Capabilities within the company
N = Capabilities within a national organization
F = Capabilities provided by a foreign company

3.5. Syria Arab Republic

3.5.1 General state of technology transfer

A quick review of the industry shows that those projects which were contracted on a turnkey basis were executed within their prescribed time schedules, as per contractual terms, thus avoiding delays and serious implementation problems.

Turnkey agreements are widely recognized as one of the methods of transfer of technology. However, in order for this transfer to be an efficient one, it should not only be restricted to timely implementation of the industrial project, but should also ensure proper and smooth running after start-up. This means that transfer of skill and know-how should accompany the transfer of physical plant, because the learning processes needed for this to take place ought to be designed from the start and given due priority.

Manpower training has been given special attention right from the contracting stage or the beginning of implementation. In some instances, training of personnel needed for manning the newly established plants ran side by side with physical implementation, according to a well elaborated plan of action, whereby actual training took place in the countries of the suppliers. Nevertheless, once the commissioning stage was reached, most if not all of these trained people left for more tempting jobs, thus depriving the plant of their services and acquired skills. Management was hence compelled to resort to contracting a few high salaried experts to enable smooth plant operation and undertake training of newly recruited personnel. This meant a net increase in production costs and the impossibility of projects realizing envisaged profits for quite a while.

On the other hand, those projects which were not implemented on a turnkey basis, that is, where only machinery and equipment were imported and installation and erection were undertaken by local enterprises or skills, with or without foreign expertise assistance, often suffered from serious and long delays in implementation. Such long delays had the further effect of inducing a drain of skills to more tempting or better paying jobs, thus seriously affecting the process of technology transfer, adaptation, and assimilation.

Notwithstanding such negative aspects, considerable technological skills and capabilities have been accumulated over the years in many capital goods and heavy engineering industries. Manpower training schemes are being developed and implemented to improve technical levels, raise productivity and make up for eventual losses or drain of skills.

Self-reliance of these industries in the production of spare parts for machinery and equipment is still lagging behind, and such production is so far limited to simple pieces and parts. The diversity of sources of machinery and equipment constitutes the main constraint on development of spare parts manufacturing.

In connection with engineering studies and design and process development, the General Establishment of Engineering Industries, which is the holding company of these enterprises, has adopted the policy of creating within its own organization a special department which is intended to be a sort of technological and expertise pool to undertake the jobs and responsibilities just mentioned. Such a pooling is expected to be promising and to give positive results.

3.5.2 Assessment of technological capabilities

(a) The Al-Furat Tractor Company[1/] is the largest capital goods Company in the Syrian Arab Republic. An assessment of its capabilities should indicate the state of capabilities in the capital goods industry.

The Company manufactures agricultural tractors and equipment.

Within the next five years it intends to develop the existing tractor (70 hp) and introduce a new model (45 hp), and manufacture some spare parts for cement factories.

The Company employed 945 people in 1983, as follows:

2	Top managers
114	Administrators and managers
5	Chemists
5	Electrical engineers
30	Mechanical engineers
1	Electronic engineer
1	Civil engineer
5	Chemical engineers
6	Economists
776	Technicians.

The Company uses Spanish technology (Maer Iberica) and Polish technology (Centrofab) according to licensing agreements. The constraints imposed on it include prohibitions against the following:

1/ The only capital goods manufacturing establishment in the Syrian Arab Republic that filled in a questionnaire.

- Transfer of technology to a third party
- Passing on technical documents or plans to a third party.

The Company lists the main problems it encounters as follows:

- Multiplicity of decision-making organizations
- Lengthy procedure to obtain approvals.

The various capabilities of the Al-Furat Tractor Company are tabulated in table 48, which indicates the following:

- The Company relies exclusively on foreign capabilities for pre-feasibility study, feasibility study, factory design and products design, and on local consultants and contractors for engineering and construction work.

- The Company relies on its own capabilities and those of foreign companies for process design. For training it relies on all available capabilities: in-house, regional, and foreign.

- The Company relies on itself for maintenance, R and D, after-sales services and marketing.

The Company's experience in operation and production has been successful as described below:

(i) The Foundry Shop a number of engineers and technicians underwent training in the country which supplied the shop's machinery (Poland). Installation and erection work was carried out by the Company's personnel, under Polish experts' supervision. The Polish side was responsible for installation and start-up trial runs in the various parts of the foundry.

Afterwards, the Company availed itself of the services of Spanish experts to supervise production of parts needed for the tractors. Now the foundry is entirely operated by the Company's engineers, technicians and trained workers without any foreign technical assistance.

(ii) The Forging Shop, most of the machinery in this shop was installed by the Company's personnel, and only a few items have been installed under foreign experts' supervision. Local technicians and workers were trained in Motor Iberica's plant in Spain and shop operation was started under supervision of Iberica's experts.

At present the forging shop is run by the Company's trained personnel and no foreign expertise is needed.

(iii) The Machine Shop, the Company's personnel installed most of the machinery in the machine shop. Some of the thermal treatment equipment was installed under the supervision of experts sent by the suppliers.

Table 48. Technological Capabilities of the Al-Furat Tractor Co. in the Syrian Arab Republic

	Company itself	National organization	Foreign companies
Sources of technology			Spanish (Motor Iberica) (Polish Centrofab)
Selection of Technology	Yes		
Pre-feasibility study	None		Indian consultants office 100%
Feasibility study	None		Indian consultants office 100%
Engineering	None	Local consultant 100%	
Factory design	None		Indian consultants office 100%
Construction	None	Local contractors 100%	
Product design	None		German Democratic Republic and other concerned companies 100%
Process design	Yes 10%		Foreign companies 90%
Maintenance	Yes 100%		
Mfg. of spare parts	Yes limited		
R and D		Yes 100%	
After-sales service	Yes 100%		
Training	Yes	Specialized centres	Motor Iberica (Spain) Centrofab Co. (Poland)
Marketing	Yes 100%		

Source: Compiled by the Joint ESCWA/UNIDO Industry Division.

A number of workers were trained in Spain at Motor Iberica's Plant but their training was not efficient. It was not of much use perhaps because it took place long before operation start-up. This training, therefore, had to be repeated. Trail runs and actual operation of the shop were carried out under Motor Iberica's experts supervision.

The entire machine shop is now operated by the Company's personnel; no foreign experts are required.

(iv) The Press Shop, all machinery and equipment in this shop was installed by the Company's personnel after undergoing the necessary training, and most of it was operated by them too. Motor Iberica's experts supervised trial runs and start-up operations. Press shop operation entirely is the responsibility of the Company's personnel.

(v) The Assembly Shop, assembly work and manufacturing and maintenance operations are all undertaken by the Company's engineers and technicians, without any foreign assistance. Some of them underwent training abroad on such jobs.

(b) The General Company for Technical Consultancy and Studies

The Company is a public sector company established in 1980. Its activities encompass the following:

- Pre-feasibility study
- Feasibility study
- Factory design
- Engineering
- Construction
- Supervision of construction.

It is not involved in product or process design, R and D, maintenance, marketing and after-sales services.

The Company conducted pre-feasibility studies on electric power stations and transport equipment, among others, and engineering work and design for many projects.

The Company employed, as of 31 December 1984, 1,505 people in four centres as follows:

781 Engineers
465 Technicians
259 Administration, finance and services.

Out of the total number of employees there are 100 foreigners and no Arabs. The foreigners include 64 engineers, 25 scientists and one top manager.

It is clear that the Company relies significantly on foreign expertise, reportedly because of the shortage of local expertise capable of conducting

studies in such fields as petroleum, city planning and organization of workshops. The Company arranges for the training of its staff at the national universities and within its facilities as well as in foreign countries.

The Company looks forward to participating as a consulting firm, with reputable international organizations, in implementing projects in the Arab countries including petroleum, petrochemicals and construction projects. It took steps in that direction with the Kuwaiti Funds in 1982.

(c) The General Company for the Execution of Industrial Projects

The Company is a public sector company established in 1977.

The activities of the Company encompass engineering, construction and supervision of construction works for industrial projects. Some of those activities pertained to the Industrial and Technological Research and Development Centre (ITRDC), the Metal Fabrication Company, the Al-Furat Tractor Company, the Cables Factory and the Electrical Motors Factory. The Company plans to increase its activities within the next five years to include establishing manufacturing workshops.

The Company employs a total of 2,000 people in seven centres. Out of these 2,000 the graduates of universities and technical schools total 217 people, only 9 of whom are non-Syrian Arabs and one a foreigner. Thus the Company basically depends on local manpower.

The Company organizes training for its staff, in specialized national centres as well as in other Arab and foreign countries.

(d) The Industrial and Technological Research and Development Centre (ITRDC)

The Centre is a public sector organization established in 1965. It is organized into various departments: textiles, electricity and mechanics, standards and inspection, documentation, technical studies, finance and administration.

The activities of the centre include research on building material, testing, quality control (cement, building materials, glass, etc.). It is not involved in product or process design. The Centre bases its activities on suggestions from its own staff as well as from industrial establishments and government agencies. In some cases, namely capital goods and to a limited extent iron and steel, the centre is involved in activities based on contracts with customers. This represents 13 to 17 per cent of its income.

The Centre utilizes expertise from international organizations (UNIDO, ESCWA, AIDO) and co-operates with these organizations. It plans to conduct applied research in the chemical and food industries as well as cement and building materials.

Out of the various national organizations, the centre stated that the Chemical Organization and the General Organization for Engineering Industries co-operated most with it. At the regional level, the Centre has forged preliminary links with the Research Centre in the Libyan Arab Jamahiriya.

The Centre employs 148 people including 28 researchers. Five of its staff have Ph.D. degrees. The Centre arranges for some of its staff to be trained abroad.

(e) University of Damascus College of Electrical and Mechanical Engineering

There are more than 7,000 registered students including 60 graduate students. The number of the teaching staff is 100, and the language of instruction is Arabic.

Main research has been thesis work relating to electrical networks, digital control using computers and solar energy.

There is no arrangement for students to conduct their research work inside factories, and no co-operation in research work with foreign universities.

The college offered advisory services and engineering consultancies. (not specified).

From the above, it can be concluded that the contribution of this college to the development of technological capabilities is limited to providing a basic electrical and mechanical engineering education.

(f) University of Aleppo

The teaching staff in architecture, civil, electrical and mechanical engineering is 77 of whom 7 are foreigners. The number of students who graduated in 1984 in these fields was 935.

The university co-ordinates with various national organizations including the Ministry of Industry regarding formulation of the curricula and number of students accepted in various fields.

The university does not have research co-operation agreements with foreign universities. However, it does have links, perhaps exchange programmes, with many foreign universities such as Karl Marx Shtat in the German Democratic Republic, Aden University in Democratic Yemen and the University of Lyon in France.

Up till now the university has not conducted research work for other organizations on a contractual or commercial basis. However, its students may opt to conduct their research in national factories such as the cement plants.

The assessment of capabilities in the capital goods industries in the Syrian Arab Republic are given in table 49 below:

Table 49: Technological capabilities in the Syrian Arab Republic's capital goods industry

Capabilities / Company	Al Furat Tractor Co.
Source of technology	F
Selection of technology	C
Pre-feasibility study	F
Feasibility study	F
Engineering	N
Factory design	F
Construction	N
Product design	F
Process design	CF
Maintenance	C
Mfg. of spare parts	C
R and D	N
After-sales service	C
Training	CNF
Marketing	C

Source: Compiled by Joint ESCWA/UNIDO Industry Division.

Note: C = Capabilities within the company
N = Capabilities within a national organization
F = Capabilities provided by a foreign company

3.6 Tunisia

3.6.1 Criteria for selection of technology transfer

It has been reported that, to assess selection criteria a survey of 11 manufacturing organizations was made; out of the 11, only 5 were public sector organizations. Four organizations had obtained patent licences, four had old technologies and managed through the use of technical assistance agreements. Three had trademark licences, plus technical assistance, and only one organization was established on the basis of a turnkey contract (table 23).

In the organizations with a patent licence, the criteria used were:

(a) Selection of a party with a wide marketing base on the national level;

(b) Availability of spare parts, plus training assistance for workers and maintenance services.

The process of co-operation with foreign partners starts with selection of the products required for manufacturing through import licence; the second stage is the undertaking of some simple operations such as assemblage of simple parts (C.K.D.). The third stage establishes a production unit and

includes agreements with the foreign parties to participate in the Company capital, or to buy part of the locally manufactured products, to be incorporated in products made abroad. There are guarantees for locally manufactured products through trademarks or quality control services.

Other criteria are international reputation and suitability of products to local conditions. A period of commercial commissioning by the foreign partner is a primary condition for testing the products and the seriousness of the parties involved.

The main criteria for technology transfer selection are as follows:

- Participation in company's capital
- Encouragement of integration of local content (over 50 per cent)
- Solving technical obstacles
- Training of personnel
- Providing all required research, designs, production procedures and quality control services
- Providing technical assistance or training programmes.

Usually financial and commercial factors play a big role in the selection process.

In organizations which have developed their own technologies internally, there is dependence on the past experience of the organization and on known technology processes such as general mechanical operations and welding formations. Foreign technical assistance has been used in cases of specific technical obstacles such as maintenance and adaptation, and for making use of modern methods of operation.

Organizations which use foreign technical assistance usually have sufficient capabilities with regard to engineers and technicians, but they tend to use sufficient foreign assistance to develop or promote certain technological capabilities by working in co-operation with the foreign experts, with the organizations guaranteed independence and local control.

The selection of turnkey agreement has been used in mechanical industries only, especially in the Al-Sahel automated factory, which was established in 1962, after an international tender which was won by the Polish company (CEKOP). The number of operations needed for producing the group of products and the lack of required skilled staff necessitated this selection. The choice was based on commercial benefits; however, this experience resulted in many mistakes and technical problems, especially in operation and maintenance, and this method was never used after that time.

3.6.2 Assessment of technological capabilities

The manufacturing industries consist of some 300 organizations (including iron and steel), which employ over 24,000 persons in the different

levels of production, administration and management and though these industries have developed their technological capabilities, a major part of the technology transfer process, face a great number of obstacles, mainly because these organizations have not been well prepared to overcome such problems. The subsector for mechanical formations and operations includes over 120 organizations in different activities: a selected number of companies are described in tables 24 to 26. A previous survey of 25 organizations found that only five have research centres, three have programming and methods and three have centres for quality control. This subsector is lacking in design and adaptation: the designs are usually owned by the patent owner or the provider of production units or the foreign partner who co-operates with the organization. The number of skilled managers is limited, and the specialized necessary skills which are important to the development of the sector, such as mechanical formations, spare parts and thermo-processing, are not available.

In the welded structures or products sector, which comprises over 130 companies employing some 13,000, the following details are clear:

- The capacities for adaptation and design are less than 50 per cent in 37 companies out of 55.

- Forty-three out of 59 organizations have no research centre.

- Forty-seven out of 59 organizations have no programming and procedures centres.

However, there are six companies, with a complete organizational set-up, which shows that this subsector has a capacity that can be effectively developed.

Some companies have greatly developed their technical capabilities to promote activities using the following: cement kilns, offshore sites for oil exploration, cylindrical liquid gas storage tanks and railway wagons.

The electric industries subsector, which includes over 60 companies and employs over 2.700 persons, is mainly made up of small-scale organizations (over 70 per cent of the total), whose activities are limited to producing electrical and mechanical parts based on metal sheets technology; the others are assembly units.

The following companies provided detailed information by answering the questionnaires on the technological capabilities within their companies (see tables 50 to 57).

The Foundry and Mechanics Company (SOFOMECA)

The Company has internal capabilities to undertake pre-feasibility studies, while feasibility studies are carried out with the participation of foreign engineering and consulting firms. The Company is planning at present to renovate and expand production of mechanical tools, for which construction of a new plant is under study. A foreign firm (George Fisher) is undertaking the pre-feasibility study for this expansion with the help of company personnel. The same firm is also undertaking the engineering and plant design of the new plant, and the engineering design for the renovation of existing production units.

The Company reports that it undertakes independently most of the other technological capabilities, such as product and process design, marketing, maintenance and after-sales services. They have internal specialized sections to perform these capabilities such as the technical unit, trading unit and maintenance unit.

The Company produces some of the required spare parts; however, this production is not sufficient and they solve some of their spare parts problems through imports. The Company tries to meet the needs of the cement industry and the metal trailers (wagons) company, since both use the Company's products. There are no links with national laboratories and research centres, yet the Company mentioned the national civil and mechanical construction companies, which have participated in the construction of the Company and its planned future expansion programmes.

All employees are nationals. There are 176 employees with vocational training, six with first degree education, 10 with a masters degree and 3 with a doctorate. The high-level posts are distributed as follows: 14 in administration, 1 chemist and 20 in the different engineering posts.

The Company does not report any internal training programmes. Some training is undertaken abroad within technology owner companies. The Company evaluates the education at all levels, as only satisfactory. The source of used technology is foreign (American, German and Spanish).

Foreign firms studied the alternate sources of technology; the final selection was made internally. The form of acquisition used is patent licence. The Company has not undertaken any studies or research to develop the acquired technology. To develop the process of technology transfer the following suggestions are given:

(a) Specify in detail the products required according to local needs;

(b) Convince the Tunisian specialists and scientists to work in technological fields;

(c) Negotiate contractual terms and select technical partners;

(d) Convince nationals of the relevance of transferred technology and train personnel at technology owner company;

(e) Buy the required production equipment.

<u>The Industrial Hydromechanic Company (Hydromeca) and SICAME</u>

The Company reports that it has internal capabilities to undertake pre-feasibility studies at 100 per cent capacity, feasibility studies at 80 per cent, engineering and plant design 80 per cent, marketing at 100 per cent, research and development 50 per cent. The rest is undertaken with the help of both foreign and national organizations.

Table 50. Technological capabilities of the Foundry and Mechanics Company (SOFOMECA) in Tunisia

Technological capabilities	Company itself	National organization	Foreign companies
Source of technology			AMSTED(USA),(FRC) CAF.(Spain)
Selection of technology	Yes		Participates in Selection
Pre-feasibility study	Yes		George Fisher (Engineering)
Feasibility study	Yes 20%		George Fisher (80%)
Engineering	None		George Fisher (100%)
Factory design	None		George Fisher
Construction		Yes	
Product design	Yes		
Process design	Yes		
Maintenance	Yes		
Manufacturing of spare parts	Yes		
R and D	None		
After-sales service	Yes		
Training	Yes		CAF (Spain), RVI.
Marketing	Yes		

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Foreign help is acquired through the technology licence agreement, to undertake feasibility studies, engineering, plant, product and process design, marketing, maintenance, R and D and after-sales services.

The national organizations that have participated in the development of the Company and in its future expansion programmes have the following technological capabilities:

(a) The Central Bank and the General Industrial Administration in selection of technology:

(b) National construction organizations in construction and supervision;

(c) The technical centre for mechanic and electric industries and the national engineers school in R and D activities;

(d) Export development centre in marketing activities.

The Company has plans to expand its production facilities and increase the variety of its products to meet the local needs; for that an expansion programme is under study. The Company plans to undertake all related technological activities internally.

The Company reports that it produces its own spare parts. It has faced a few technological problems such as suitability of raw materials, absorbing the technology and quality control. These problems were solved through experience and control, maintenance procedures and training of employees internally in national organizations and abroad.

The technology used is foreign, mainly French. The selection of technology, study of alternates and final decision is undertaken locally, by the Company and in co-operation with the concerned authorities. The form of acquisition of technology is limited licence contracts.

The Company believes that it has acquired an advanced technology and was able in a short period to master it and adapt it to its needs.

The Societe Industrielle du Nord (SIN)

The Company reports that most technological capabilities have been developed within the Company, except engineering, plant and process design. The Company does not undertake any research nor does it manufacture any of the required spare parts. The Company solved difficulties of technology absorption through experience and on-site training with guidance from foreign experts. Selection of technology and study of alternates are carried out internally with the help of foreign experts.

Africa Industrie

The Company has managed to build, since its establishment in 1974, the following capabilities, for which they depend completely on nationals: pre-feasibility studies, engineering and product design, after-sales services

Table 51. Technological capabilities of the Industrial Hydromechanic Company (Hydromeca) (SICAME) in Tunisia

Technological capabilities	Company itself	National Organizations	Foreign companies
Source of technology			French
Selection of technology	Yes	Central Bank General Industrial Administration	
Pre-feasibility study	Yes 100%		Participation of technology owner
Feasibility study	Yes 80%		Participation of technology owner
Engineering	Yes		Participation of technology owner
Factory design	Yes 80%		Participation of technology owner
Construction		National Construction Organization	Participation of technology owner
Product design	Yes		Participation of technology owner
Process design	Yes		Participation of technology owner
Maintenance	Yes		Participation of technology owner
Manufacturing of spare parts	Yes		Participation of technology owner
R and D	Yes 50%	Technical Center for Mech.& Electric Indus. High National Engineering School	
After-sales service	Yes		Participation of technology owner
Training	Yes		Participation of technology owner
Marketing	Yes100%		

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 52. Technological capabilities of the Societe Industrielle du Nord (SIN) in Tunisia

Technological capabilities	Company itself	National Organizations	Foreign companies
Source of technology		Foundry and Mechanics Company	Italy (Officini Piccini) French (Laspa)
Selection of technology	Yes		
Pre-feasibility study	Yes		
Feasibility study	Yes		
Engineering	None		
Factory design	None		
Construction	None		
Product design	Yes		
Process design	None		
Maintenance	Yes		
Manufacturing of spare parts	None		
R and D	None		
After-sales service	Yes		
Training	Yes		
Marketing	Yes		Headquarter of foreign partner Foreign partner participates

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 53. Technological capabilities of the Africa Industries in Tunisia

Technological capabilities	Company itself	National Organizations	Foreign companies
Source of technology			
Selection of technology	Yes		
Pre-feasibility study	Yes	100%	
Feasibility study			
Engineering	Yes	100%	
Factory design			
Construction			
Product design	Yes	100%	
Process design			
Maintenance			
Manufacturing of spare parts	Yes		
R and D			
After-sales service	Yes	100%	
Training	No		
Marketing	Yes	100%	

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

and marketing. As for other technological capabilities, such as feasibility studies, factory and process design, maintenance, research and development and construction activities, no mention is made of any internal registered capabilities in these fields. At the same time, no technological difficulties are facing the Company nor does it have any need for foreign assistance.

GABUS Complex for Metal Industries and Contracting (ACMG)

The complex is new; it started production in 1980 at the same time the Company claims that it has built internally the following technological capabilities: pre-feasibility and feasibility process design, maintenance, marketing and after-sales services and R and D, which involves research done in co-operation with the Technical Centre for the mechanical and electric industry. The National Company for Railways (SNCFT) has provided the Company with assistance in the following fields: selection of technology, engineering and plant design, construction and product design.

Foreign assistance agreement included in the contract with the technology supplier provides some technical assistance, such as: factory design and engineering, process design, maintenance and training of nationals abroad.

The Tunisian Electromechanical Engineering Company (SACEM)

The Company reports that technical capabilities available within the Company, such as product and process design, marketing and maintenance and after-sales services are at 100 per cent capacity. Other capabilities, such as pre-feasibility, feasibility, plant design and R and D, are at only 50 per cent capacity. To supplement internal capabilities use is made of other organizations (national or foreign). The National Organization "Tunisia Consult" and C.N.E.I. provide the pre-feasibility studies and Tunisia Consult provides feasibility and engineering activities. CETIME is a national research centre that contributes to the R and D undertaken by the Company. Another national organization (CEPEX) undertakes marketing studies.

Foreign assistance has been used in factory design and construction, in maintenance and in R and D by a foreign firm (INNORPI). Two companies, one local (ENGEBAT) and one foreign (BURAFRICAINE) have undertaken construction.

The Company reports that the source of technology used is local conforming to international standards as for example, in the technology of welding.

The Company also states that it depends on foreign experts to solve few technological difficulties that arise and that these experts always work with national counterparts. Difficulties cited include maintenance problems, quality control and technology absorption.

The Company is planning as part of its diversification programme to produce spare parts for electric transformers and electric water heaters.

The Company has an internal training programme for new and on-the-job workers; they also conduct regular periodic training in national training centres and abroad in sensitive fields and activities such as maintenance, quality control and production procedures.

Table 54. Technological capabilities of the GABUS Complex for Metal Industries and Contracting (ACMG) in Tunisia

Technological capabilities	Company itself	National Organizations	Foreign companies
Source of technology			Yes
Selection of technology	Yes	The National Company for Railways (SNCFT)	
Pre-feasibility study	Yes		
Feasibility study	Yes	SNCFT	
Engineering		SNCFT	Foreign assistance
Factory design		SNCFT	Foreign assistance
Construction		Yes	
Product design		SNCFT	
Process design	Yes		Foreign assistance
Maintenance	Yes		Foreign assistance
Manufacturing of spare parts	Yes		
R and D	Yes	The Technical Centre (CETIME) for Mechanical and Electrical Industries	
After-sales service	Yes		
Training	Yes	Yes	Training abroad
Marketing	Yes		

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 55. Technological capabilities of the Tunisian Company for Electromechanical Engineering (SACEM)

Technological capabilities	Company itself	National Organizations	Foreign companies
Source of technology	Local		
Selection of technology	Yes		
Pre-feasibility study	Yes 50%	Tunisie Consult and C.N.E.I.	
Feasibility study	Yes 50%	Tunisie Consult	
Engineering	No	Tunisie Consult	
Factory design	Yes 50%		
Construction		ENGEBAT	Atkins & Partners 50% per cent BURAFRICAINE BREDEROT
Product design	Yes 100%		
Process design	Yes 100%		
Maintenance	Yes 100%	Yes	
Manufacturing of spare parts	Planned		
R and D	Yes 50%	CETIME*	INNORPI*
After-sales service	Yes 100%		
Training	Yes	Yes	Yes
Marketing	Yes 100%	CEPEX*	

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

* Abbreviated names have been provided without full titles.

The Industrial Company for Electric and Telephone Cables (CHAKIRA)

This company has indicated that all technological capabilities are available within the Company. Some technical assistance is acquired in co-operation with national organizations, such as the investment development agency, which studies alternate technologies and assists in their selection. Other national organizations not mentioned by name participate in undertaking technical activities such as engineering, construction and training programmes.

An American firm provided the technology and the factory design, product and process design. The technical difficulty cited is in spare parts acquisition which is solved through imports.

Internal training programmes in national and foreign centres are provided for the existing and new appointees. The Company plans in the coming five years to expand its production; for that, an American firm is undertaking pre-feasibility and feasibility studies with the participation of the Company. This firm is also expected to execute with the participation of national engineers from within the Company, the engineering and the plant, production and process designs.

The Industrial Company for Electric Equipment (SIAME)

The Company has internal capabilities to undertake pre-feasibility studies at 100 per cent capacity. For other technological capabilities the Company depends on national organizations, such as the Tunisian Electric and Gas Company, for selection of technology and study of alternates and engineering activities. The national research and consulting centres and offices undertake product design. Other national related organizations undertake training of employees and construction activities.

The Company faced some technical problems related to spare parts acquisition and maintenance; these problems have been solved through imports and contracting of foreign expertise.

Foreign assistance is required mainly in maintenance and training of nationals in similar foreign industries. The technology used is mainly from Yugoslavia and France. The form of acquisition of technology is through technology licence, and some constraints are made by the technology owner, such as selling of the technology to any other partner whether national or foreign.

The Company indicates that all technical capabilities are available internally.

3.6.3 Role of official organizations in transfer of technology

The first impression from an analysis of the established related organizations,[1/] is the large number of organizations (more than 60). This shows the great interest the government had in developing both industrial and economic activity.

1/ A study undertaken by the National Centre for Industrial Research

Table 56. Technological capabilities of the Industrial Company for Electric and Telephone Cables (CHAKIRA) in Tunisia

Technological capabilities	Company itself	National Organizations	Foreign companies
Source of technology			American firm
Selection of technology	Yes	Investment Development Agency	
Pre-feasibility study	Yes		
Feasibility study	Yes		
Engineering	Yes	Yes	
Factory design	Yes		
Construction	Yes	Yes	American firm
Product design	Yes		
Process design	Yes		American firm
Maintenance	Yes		American firm
Manufacturing of spare parts	No		
R and D	Yes		
After-sales service	Yes		
Training	Yes	Yes	Yes
Marketing	Yes		

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

Table 57. Technological capabilities of the Industrial Company for Electric Equipment (SIAME) in Tunisia

Technological capabilities	Company itself	National Organizations	Foreign companies
Source of technology			ISKRA Commerce (Yugoslavia) Marlin GERIN (France)
Selection of technology	Yes	Tunisian Electric and Gas Company	
Pre-feasibility study	Yes 100%		
Feasibility study	Yes		
Engineering	Yes	Tunisian Electric and Gas Company	
Factory design	Yes		
Construction		National organizations	
Product design	Yes	National Research and Consulting Centres	Yes
Process design			
Maintenance			
Manufacturing of spare parts			
R and D			
After-sales service			
Training	Yes	Yes	Yes
Marketing			

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

These organizations were established in response to special economic and social conditions. However, their large number resulted in problems such as duplication of work programmes or lack of sufficient activities.

No obstacles faced the process of technology transfer in the period 1970-1980, since the infrastructure, industrial sectors and official related organizations were all available. Though legal support in the form of official laws regulating the transfer of technology process was lacking but that did not affect the number of projects. The evaluation also shows that the technology transfer process was never analysed with regard to general content and future prospectives, since the concerned organizations lacked the qualified specialists to undertake this task, and because these organizations were not endowed with the necessary legal and technical facilities.

The total capabilities within these organizations provide the basic needs for control of technology transfer, though it is still lacking in coherence and directives, which makes it less effective, yet it does provide some limited services. A review of the original directives of these organizations leads to the conclusion that there is no real understanding of the role of transfer of technology.

The following organizations were surveyed; (see table 58 for the detailed technological capabilities within some of these organizations).

(a) The National Centre for Industrial Research. Established in 1968, its objectives concern industrial development and the role of development plans in manufacturing industries. The Centre undertakes techno-economic studies for industrial projects proposed in the recurring development plans, provides plans for developing new industries, and studies their viability and the financial resources needed for implementation. The Centre also assesses technical needs of existing and new industrial projects, proposes reorganization procedures for the growth and development of the industrial public and private sector and undertakes measures to survey annually all establishments in the industrial sector.

(b) The exports Development Centre. Established in 1973, its aim is to increase the commercial exports of Tunisian products. It studies local and international markets to provide information and directions for trade, increases the co-operation between production units and trade organizations and provides all services that propagate Tunisian products in world markets, such as quality control and incentives to local producers.

(c) The Technical Centre for Electrical and Mechanical Industries. Established in 1982, its aim is to provide all kinds of services to support the development of the electrical and mechanical industries sector. The Centre assists manufacturing units in solving all production problems, to ensure promotion of products, provides advice on measures to increase and promote productivity whether by developing human resources or production capacities, collects and assimilates all information related to this sector internal or international and distributes information on new developments in this field to concerned organizations.

(d) The Technical Centre for Construction and Ceramic Resources. Established in 1982, the Centre's aim is to provide technical assistance that supports the development of this sector, such as technical assistance to individual units to solve production or quality control problems.

(e) The National Centre for Standardization and Industrial Property. Established in 1982, the Centre undertakes all activities related to standardization, quality control and metallurgical services and protective measures for products and private property, provides licences and certificates, registers trade marks and patents and registers all industrial agreements related to private industrial property.

(f) Training and Social Development Authority. Established in 1983 under the Ministry of Labour, the Authority provides the government with the qualified personnel in all economic and industrial sectors. It surveys the country's training needs in all vocations and professions.

(g) Educational organizations (universities, scientific and technical research centres: The manufacturing industries are supported by the facilities provided by the Ministry of Education and Scientific Research, which includes the following:

(i) The Scientific and Technical Research Council, which incorporates 14 specialized scientific committees;

(ii) The National Scientific and Technical Research Centre which includes 11 research organs;

(iii) The National Academic, Scientific and Technical Documentation Centre, which was established in 1980, and is a data base centre which provides the universities and research centres with data and information;

(iv) The Scientific Equipment Maintenance Centre, which is in the process of being established;

(v) The Technical Teachers Training Centre which was established in 1975;

(vi) The National Institute for Engineering which was established in 1968 for training engineers in all engineering fields.

A law for financing research in the form of contracts between the Ministry and research groups within the university institutions has been passed. The Ministry of Industry and Education have defined priority areas for research programmes to be undertaken, such as:

New and renewable resources, phosphates construction. Since 1980 some 395 research contracts were signed, none of them cover capital goods or related activities.

In addition to the staff of the universities in Tunisia who number over 1,888 professors and researchers, there are only 64 researchers working for the National Scientific and Technical Research Centre, out of a total of less

than 1,000. Of this total, only the researchers (64) in the national centre and some 84 university science professors are capable of undertaking scientific research though they are busy with the academic work in the university. Therefore, there is a need to increase the number of specialized scientific and full time devoted researchers in the fields of engineering and industrial technical capabilities.

There is also a need, to encourage co-operation between the research centres and the industrial organizations which at present is lacking.

With the above-mentioned present capabilities it was and still is not possible to develop R and D without increasing the number of researchers and diversifying the research-related/activities, plus increasing investment, research projects and providing incentives for scientific and technical researchers, especially when the available engineers are too busy with following up on academic or production operations, daily procedures and management duties.

(h) Design and consultancy centres

This sector includes approximately 50 centres distributed according to the following activities:

- Supervision of construction and works	5
- Organization and training	7
- Economic and legal studies	4
- Social studies	2
- Information	12
- Industrial engineering	2
- Civil engineering	25

From this distribution, the weakness of national organizations concerned with consultancy and design for industry is clear. Only a few organs are concerned with industrial consultation and engineering and they are mainly in the public sector centres. Most of the other centres' activities in industrial promotion do not exceed simple preliminary work in projects or plant construction, such as electricity, sewage systems and water systems. Capabilities such as plant engineering and product process design, have been undertaken but were limited to the chemical, phosphate, cement and construction sectors and this is attributed to the priority given to these sectors by the authorities concerned.

Table 58. Techological capabilities in some related organizations in Tunisia

Organizations	Central Laboratory	The National Centre for Industrial Research	Investment Promotion Centre	Technical Centre for Mechanical & Electric Industry	Technical Centre for construction and Ceramics	National Institute for Standard-ization and Private Property	Training and Social Development Authority	Banks for Economic Development	Export Promotion Centre
- Industrial studies	X	X	X	X	X	X		X	
- Research and development	X			X	X	X			
- Testing and analysis	X								
- Quality control	X			X	X	X			
- Standardization				X	X	X			
- Vocational training		X		X	X	X	X		
- Production management		X	X	X	X			X	
- Technical assistance			X		X		X		
- Marketing studies		X						X	X
- Production promotion					X				X
- Industrial property						X			X
- Technological information		X		X					
- Technology selection			X	X	X			X	
- Legal consultation		X			X			X	
- Tenders and negotiation				X	X			X	
- Pre-feasibility studies		X	X	X	X			X	
- Feasibility studies		X		X	X			X	
- Plant design		X		X	X				
- Engineering									
- Construction and supervision				X	X				
- Product design				X	X				
- Process design					X				X
- Marketing services				X	X				
- Maintenance									

Source: Compiled by Joint ESCWA/UNIDO Industry Division, based on national sources.

The above assessment of technological capabilities in the Tunisian capital goods industry is summarized in table 59 below.

Table 59: Technological capabilities in the Tunisian capital goods industry

Capabilities / Company	SOFOMECA	HYDROMECA	SIN	ACME	African Industrie	SACEM	CHAKIRA	SIAME
Source of technology	F	F	NF	F		C	F	F
Selection of technology	CF	CN	CF	CN	C	C	CN	CN
Pre-feasibility study	CF	C	C	C	C	CN	C	C
Feasibility study	CF	CF	C	CN		CN	C	C
Engineering	F	CF		NF	C	N	CN	CN
Factory design	F	CF		NF		CF	CF	C
Construction	N	NF		N		NF	CN	N
Product design	C	CF	C	N	C	C	CF	CN
Process design	C	CF		CF		C	CF	F
Maintenance	C	CF	C	CF		C	C	
Mfg. of spare parts	C	CF		C	C			
R and D	-	CNF		CN		CNF	C	
After-sales service	C	CF	C	C	C	C	C	
Training	CF	CF	CF	CNF		CNF	CNF	CNF
Marketing	C	C	CF	C	C	CN	C	

Source: Compiled by Joint ESCWA/UNIDO Industry Division.

Note: C = Capabilities within the company
N = Capabilities within a national organization
F = Capabilities provided by a foreign company

PART IV

FUTURE TECHNOLOGIES

4.1 Sources of technological changes

Future changes in the technologies of engineering and capital goods industries will stem from three sources:

(a) Changes in the technology of the end use products;

(b) The need to reduce production costs, labour inputs and capital cost and to improve the quality and performance of the equipment;

(c) New applications and technologies in the dynamic industries such as microelectronics and space industries.

The first source of change stems from the nature of the capital goods industry, namely that its products are used to produce other products and services. For example, every change in the process of producing a chemical must be accompanied by a change in the design of the respective capital goods equipment. If new chemicals are developed then research must be undertaken to find appropriate materials to handle the chemicals at various stages of processing, storage and transport, e.g. new alloys, cladder metals and lining materials. Each new material developed causes an engineering design and production technology change. Cost reduction and performance improvement of the products of engineering and capital goods industries are also important reasons for technological changes in the industry. New products and design systems, new production processes, new materials, new design concepts and new applications are usually initiated within the industry or its technological infrastructure.

New technological areas such as aviation, microelectronics and space exploration give rise to the development of new materials and thereby new engineering design and processes, new production systems etc. which can have applications in other industries. Striking examples are use of titanium, zirconium, ceramic metals, reinforced fibres etc. in space applications. Microelectronics has changed the concepts of control and production systems, with, for example, robotization, numerical controls and flexible manufacturing systems.

While the projection of the direction and rate of technological change in the future is a wide subject by itself requiring constant monitoring of technological changes through intelligence mechanizing, it can be said here that change in this industry will perhaps be the fastest compared with other industries. On the other hand it can also be said that, especially in the context of the developing countries, the industry is quite stable in the sense that technological innovations can be adopted and adapted in relatively short periods and investments in the industry do not become redundant provided care is exercised in the initial selection of technology and in updating it.

The industry will continue to undergo technological developments in many areas, including:

- Materials: new alloys, metals, and fibre materials;

- Processes: machining, metal forming, cutting, etc.;

- Design: computer-aided design, modular concepts, etc.;

- Manufacturing: computer-aided manufacturing, robotization, etc.;

- Management: computer-based management systems, computer data base information system.

The dependence of this industry on computers will therefore continue to increase. Besides enhancing production and associated activities, the new computer technologies have a great influence on both the technological infrastructure and the technology transfer process itself. They have penetrated all stages of the technological infrastructure: project identification, feasibility studies, engineering and construction, plant design, marketing, sales, research and development. With the new available hardware and software, it is possible to carry out more complex tasks more efficiently and systematically, while reducing the time required and the manpower costs. These systems (hardware and software) are readily available and it is possible to learn to use them without major effort. Thus, many aspects of technology are becoming more accessible to developing countries leading to a significant increase in technological capacity. This has been coupled with enhanced accessibility to the sources of information via the multitude of data banks and data bases and the large number of international software houses.

Developing countries need to use the new computer-based technologies in order to benefit from their contributions to productivity, efficiency and overall technological capacity. However, in order to minimize the potential of increasing dependence on technology sources, they need to build up their own capabilities in computer technology at both the hardware and software levels, especially the latter. It is recommended that, while the various levels of technological activity in the Arab world acquire and use computer technologies, efforts should be made at universities, research institutions and industrial establishments in order to develop the necessary competence in the computer field. The ultimate objective should be to develop indigenous software capabilities and, to the extent possible, some aspects of hardware systems capabilities.

Manufacturers will continue to encourage automation and increase the use of robotics, flexible manufacturing systems and CAD/CAM as a means for improvement in such industries as the automotive, aerospace, electronics and machine tools industries.

Published information (including information from ECE governments) contains estimates that approximately 350 to 400 FMS were installed on a world-wide basis in 1984-1985, covering mainly FMS for metal-cutting and metal-forming. Flexible automatic assembly systems are partially accounted for in these estimates but robot-based flexible spot-welding lines used by some automotive producers are not included. The most important trends through 1990 would be the development and implementation of FMS and their modules, as

well as standardized and unified sub-assemblies for them, the achievement of total factory automation (unmanned factory) and the development of laser applications for FMS.

Technological progress of FMS expected or aimed at is as follows*:

- Machines: Future manufacturing systems will contain complex and compact, multifunction, multi-spindle machines rather than a series of work-stations.

- Cutting speed will double (from 1955 to the present cutting speed has increased from 60 m/min to 480 m/min on average).

- The rigidity of the machines will increase by a factor of five.

- The machines will be sensor-equipped (vision-tactile sensors etc.).

- The machines will be adaptive and have self-diagnostic systems.

- Computer control systems: The major advances will continue to be in the computer and electronics field.

- Artificial intelligence: Research will, in the next few years, provide not only the software for visual pattern recognition in robotics and graphics input or speech recognition and synthesis for vocal communication but also the situation-recognition and decision-making apparatus necessary for failure detection, diagnosis and the automatic establishment of recovery strategies.

- Data-base technology, particularly the development of minicomputer-based distribution, and relational data bases, will help both to distribute and to integrate the CAM system.

- Very high level programming languages such as PASCAL and, more recently, ADA will not only speed programming and make programmes more easily transportable but will also provide automatic documentation, permitting on-site programme maintenance and enhancement.

- Operating systems and network: New, smaller and more efficient operating systems are permitting easier use of computer-based systems by people whose expertise lies more in the application field. Networking research, particularly on distributed processing, is laying the foundation for highly resilient, self-configuring systems.

Perhaps the best way to draw the main directions of current and future technological changes is to examine what is happening in the machine tool industry which produce machines that produce other capital goods and engineering products.

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* See ECE report on "Recent Trends in Flexible Manufacturing", 1985.

4.2 Expected developments in machine tool technology

The expected direction of future technological changes in the machine tools industry[1/] is summarized below:

Materials

Metals - Titanium, Zirconium, Tantadium
New alloys
Fibre materials - glass, boron, carbon
Cement (low cost materials to increase weight of machine beds)
Ceramics
Sinteved materials

Processes

Machining

Electron discharge
Chemical and electrochemical processes
Ultrasonic processes
Laser machining
Abrasive jet
Electronic beam
Spark erosion
Plasma arc
Ion Beam
Waterjet
New finishing methods

Metal forming

Powder metallurgy
Explosion Forging
Electro Deposition
Helical and ring rolling, spinning, rotary forging
Use of numerical control and pressure sensing
Electro-hydraulic, compressed gas methods
Electromagnetic
Vacuum forming
Use of antimony and other reusable materials

1/ See United Nations Industrial Development Organization, "Technology perspectives in machine tools industry and their implications for developing countries", Development and Transfer of Technology Series, No. 19.

Cutting tools

Better carbides (new combinations)
Coated carbides
Nitrides
Diamond
Ceramics
Frozen Water/chemical
Chip making
Tools for new cutting and forming processes
Tools geometry

Design and design methods

Computer-aided design - software development
Modular concepts
Hydraulic, electro-hydraulic, electromagnetic systems
Electronic controls, NC, CNC and DNC
Hard-coated surfaces for bearings, guideways, etc.
Hydraulic bearings
Use of laser for empirical design basis
Ergonomic
Automation and mechanization

Manufacturing systems

Computer-aided manufacturing
Flexible manufacturing systems and transfer lines
Machining centres on modular concept
Automatic tool change
Robotization
Computer-aided inspection and quality control
Group technology

The forecasts presented below were drawn by UNIDO from a report by the Technical Policy Board of the Institution of Production Engineers, United Kingdom. The report, entitled "The Way Ahead", was based on a survey conducted by means of questionnaires. The methods used derive from those of a project known as Project Delphi, sponsored by the United States Air Force in the early 1950s. Although the forecasts refer to the United Kingdom, unless otherwise specified, they can be viewed as indicative of future development in the industry.

1984-1985

1. Computer-aided manufacture will use a network of graphics terminals to inform management on the shop floor of the situation of any product and some will convey set-up and operating instructions.

2. NC machine tools will normally use floppy discs instead of paper tape.

3. The cost of programming will be reduced by one third by means of computer aids on interactive pre- and post-processing and expanded data bases. Computer graphics will be in use for CAD and CAM by about 5 per cent of all companies.

4. Computer-aided material-handling systems integrated with manufacture will be used by a small (2 per cent) but growing number of companies.

5. Smaller companies will have only 1 per cent of their work designed by computer interactive graphics.

6. About 10 per cent of all the manufacturing industry will have a considerable amount of automatic inspection (on line 0 with diminishing post-manufacture inspection). This process will extend well beyond engineering products into such areas as textiles, paper and box or can manufacture, and will develop continuously.

7. The proportion of companies using integrated CAD and CAM for both product and tool design will be as follows:

	1984-1985 (percentage)	1990 (percentage)
Japan	10	20
United Kingdom	5	10
United States	10	25

8. Managers expect working hours to be reduced to 38 per week.

9. Workers will be consulted in at least 30 per cent of all companies engaged in manufacturing.

10. Office staff will work under some form of productivity scheme, though this is considered difficult to establish.

11. Computers will be used by the majority of manufacturing units, especially those with at least 250 employees. Most processing plans will be carried out by computers, thus reducing management paperwork.

12. About 50 per cent of manufacturers will have costing and machine scheduling on computers. This information will be available to managers on request by means of visual display units.

13. Minicomputers and microcomputers will be used to assist both physical movement and information in materials handling.

14. In precision turning and grinding, in process sensing of finish and dimensions, scrap will be reduced by 25 per cent and much post-manufacture inspection eliminated.

15. It should be possible to predict and specify the surface finish needed to give the required wear life in rotating shafts or sliding surface.

16. Adaptive control strategies for metal removal by turning, rolling or grinding will be available and these will be adopted by 10 per cent of the industry.

17. Both paint spraying and automatic welding by robots will be widespread (up to 40 per cent of the industry).

18. Lasers will be used for in-process (non-contract) control of accuracy.

19. The structure of most new machine tools will be composite to avoid vibration and to give stiffness and thermal stability and reduce noise.

20. In the United States many industries (up to 10 per cent by 1987) will use group technology.

21. Lasers will be used for cutting and welding in both the United Kingdom and the United States.

22. Software systems will be developed to predict costs based on capital definition only.

23. About 75 per cent of United States assembly systems will have automatic inspection.

24. By 1985 direct labour in car assembly will be replaced by programmable automation (probably up to 30 per cent).

25. Part storage and retrieval in the United States will be automatic.

1986-1987

1. In the United States 10 per cent of all machining will be done by group technology by 1987.

2. Working hours will be reduced to 36 per cent.

3. It will be possible to use the computer to indicate whether it is economical to employ group technology for any particular part.

4. In larger firms 50 per cent of all the process paperwork for manufacturing will be computer-generated. As a result there will be a 25 to 30 per cent reduction in machine-tool programmers, and more CAM will lead to more CAD.

5. About 20 per cent of all printed circuit board and electronic manufacturers will use capital classification and coding systems.

6. About 50 per cent of electrical wire harnesses and automotive harnesses, insofar as they exist in their present form, will be designed by CAD.

7. Automatic assembly will have penetrated into 20 per cent of mass-production companies.

8. The Japanese predict coding of sheet metal capitals for classification by 20 per cent of companies.

9. A harmonized scheme of working for most of the work force will exist. There will be few hourly paid workers, but flexible hours of work for office staff will not extend to production workers in general.

10. There will be a considerable extension of all types of standards as a result of EEC regulations and health, safety and consumer protection, and also for manufacturing reasons.

11. Most NC machines will have dedicated microcomputers.

12. Spark erosion will have developed and become the dominant method for tool making.

13. About 20 per cent of mass-production companies will be using dedicated automatic assembly and modular robots will make equipment prices competitive, with specially designed single-purpose automatic assembly equipment. These will be in small quantity until 1990.

14. In the United States 50 per cent of new machine tools manufactured will have NC.

1988-1989

1. In the field of electronics manufacture the industry is expected to be a leader in the application of computer-aided ideas. CAD and CAM will be applied by 50 per cent of the industry.

2. Computer programmes for die-making control and optimum design will exist.

3. By 1989 about 75 per cent of all CAM systems will be relying on distributed computing system concepts. Only 10 to 20 per cent of the systems will rely on control or main frame computers.

The percentage breakdown of the different systems in use will be as follows:

	NC	CNC	DNC
Japan	30	40	30
United Kingdom	10	80	10
United States	20	50	25

4. There is considerable doubt as to whether any large proportion of NC machines will employ conversational interrogation based on set menus from the shop floor, since control would probably be lost in large units. Some specialized small units may use this for jobbing work.

5. In the United States 20 per cent of manufacturers will have a computer model of their operations.

6. About 20 per cent of mass production industry will use dedicated automatic assembly robots.

7. Central computers will control 80 per cent of in-process and finished parts inventory.

1990-1991

1. It may be necessary to ration energy and certain raw materials, particularly metals.

2. About 10 per cent of all special tools and fixtures will be designed by interactive computer graphics.

3. About 25 per cent of all machine parts will be designed by interactive computer graphics in the larger companies and 10 per cent of the results will be introduced through CAM.

4. About 10 per cent of all machining operations and some types of fabrication will be carried out by group technology or cell operations in the larger companies. This procedure has not always been economical for the foundry or for fabrication.

5. About 50 per cent of process plans will be computer-generated in the larger companies.

6. The development of optical scanning of drawings and digitizing will put CAM data into data bases for either retention or subsequent processing. Some engineers question the economics of this development.

7. Classification of laser (optical) scanning of labels for inventory control will be used by 10 per cent of companies in materials handling.

8. About 25 per cent of set-up and operations instructions will be conveyed on video screens from computer graphics to the shop-floor supervisors.

9. Seventy-five per cent of all conventional NC equipment will have been replaced by CNC or more probably DNC equipment.

10. About 20 per cent of all small-batch companies will use programmable robots for some forms of automatic assemblies, but usually not when the batch size is less than 50.

11. Paper tape will be largely superseded by CNC video display units with floppy discs or diskettes capable of supplying job operations, graphics and set-up data instructions to the operators.

12. In the United States the work week is expected to decline to 32 hours and 50 per cent of the work-force will be skilled.

13. About 50 per cent of the work-force in manufacturing will be skilled largely in computer maintenance.

14. In the United Kingdom and the United States 20 per cent of industry will have combined materials and process planning by computer-aided control.

15. By 1990, in Japan, the United Kingdom and the United States, methods development will be performed by computer for 33 per cent of such work. This also applies to the development of standards and for process control.

16. In the United States 75 per cent of simple programme-controlled equipment will be replaced by multi-stored programmes and multiprocessor control.

17. About 20 per cent of the industry will use adaptive control strategies for metal removal (turning, grinding and milling).

18. There will be marked reduction of noise from machine tools - possibly 85 decibels will be mandatory.

19. Robots should be able to assemble families of capitals (as opposed to single terms) because optical identification will be possible.

20. About 30 per cent of assembly will be made by structural adhesives.

1992-1993

1. About 10 per cent of smaller companies (with a staff of less than 1,000) will employ group technology or cell manufacture, although size is not a major criterion.

2. About 20 per cent of industry will have a computer model of manufacturing operations.

3. About 25 per cent of all manufacturing units will have computerized:

(a) Control of stocks;
(b) Automatic identification of items;
(c) Use of pallets to convey through the whole process (possibly by a year or so later than (a) and (b).

4. Facilities will be generally available for automatic sensing and replacement of broken or worn tools.

1994-1995

1. Robots will be installed in 50 per cent of industry where CAM is used.

2. About 25 per cent of machined parts will be designed by computer interactive graphics even in firms with less than 1,000 employees.

3. Working hours per week will be reduced to 32 but it is unlikely that a four-day-week will ever be adopted. Small companies will use group technology for 10 per cent of all machining operations.

4. About 20 per cent of all machine tools installed will have the following characteristics:

(a) Automatic loading, unloading and transfer;

(b) Sensing and changing tools for wear or breakage;
(c) Complete monitoring and recoding by computer.

5. In smaller firms, 50 per cent of process planning and manufacturing paper work for parts and assemblies will be done by computer, and 30 per cent in companies with 50 workers only.

6. Feedback (on line) subsystems will sense and correct deviations (back to the parts standards) in 25 per cent of manufacturing firms.

7. Operations in the manufacturing process will be modelled by 25 per cent of companies in 1995, and perhaps by 20 per cent even by 1992.

8. About 20 per cent of machine tools supplied will incorporate co-ordinate measuring (probably of non-contact nature) and feedback control to adjust deviations.

9. The percentage of special tool and fixture design by computer graphics will be 25 per cent.

10. Up to 25 per cent of all smaller companies (staff of 1,000 or less) will have fully adopted CAM. This will also be the case when batch sizes are normally as low as 50.

11. Industrial robots will be integrated into CAM systems in 50 per cent of companies engaged in assembly, moving etc. This may occur rather later in very small units.

12. Most of the manufacturing work-force will have to become highly skilled in diagnosis and maintenance of automatic machinery and computers.

13. Firms will hold information and motivating sessions to maintain staff morale.

1996

1. About 25 per cent of machine tools will form parts of a versatile machining system with automatic parts handling between machines with central process control.

It is considered that any results beyond this year would be unreliable.

PART V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The development of technological capabilities in the capital goods industry in the Arab world has been constrained by the following major factors:

(a) In the first place most of the countries do not have a capital goods industry in the true sense of the word. Exceptions are Egypt, Algeria and to a lesser extent Saudi Arabia, Syria, Tunisia and Iraq. The main reasons for this situation are small market size, inexperienced manpower and limited financial resources at the country level, and the absence of a regional approach to industrialization. So in fact the real challenge should be how to motivate and stimulate the Arab countries to adopt and support the concept of regional industrial development.

(b) The importance of long-term national industrial planning which includes, among other objectives, the development of local technological capabilities has been realized only recently. The objectives and modalities of technology transfer were often modulated by political orientations.

(c) In the countries that possess capital goods industries to some extent, such as Egypt, Algeria and Syria, it is not unusual to see manufacturing establishments which have been operational for over two decades and which still haven't "localized" substantially such "operational" capabilities such as engineering, process and product design, maintenance, quality control and manufacture of spare parts. One plausible explanation is that the technology contracts between the respective establishments and the foreign sources of technology did not obligate the foreign companies to provide assistance to develop local capabilities. Of course there may be other reasons. For example, sometimes countries use the turnkey approach for speeding up their industrial development or for other objectives. The fact remains that without depackaging the technology, the development of local capabilities will remain difficult.

Examination of current technological capabilities in the Arab countries indicates the following:

- The source of technologies is, in the great majority of cases, foreign. Out of 22 companies in Algeria, Egypt, Morocco, Syria and Tunisia which provided information on this matter, 19 companies stated that they relied completely on foreign sources of technology, one on national and foreign sources, one on the company together with a foreign source, and only one, the Tunisian Company for Electromechanical Engineering (SACEM), stated that it relied completely on itself.

- The selection of technologies is undertaken mainly by the companies themselves, or by relevant national organizations, or jointly by the two categories. Only in three companies in Morocco and Tunisia out of 24 in Algeria, Egypt, Morocco, the Syrian Arab Republic and Tunisia, were foreigners involved, and then jointly with local personnel, in the selection of technology. This should indicate quite an achievement on the part of the

countries concerned. In Egypt, this function is always undertaken jointly by the companies and the relevant national organizations which indicates developed interlinkages between all parties concerned with the selection of technology. In contrast to Egypt, the companies in Algeria and the Syrian Arab Republic rely on their own capabilities to select the technology. No interlinkaging with national organizations was reported in those two countries. Tunisia, on the other hand, uses all the modalities.

- Pre-feasibility studies are prepared by the companies themselves in most cases. Out of the 24 companies that answered our questionnaire, 16 do their own pre-feasibility studies, two do that jointly with relevant national organizations, five do it jointly with a foreign company, and only one, the Al-Furat Tractor Co. in the Syrian Arab Republic, stated that foreign companies prepare its pre-feasibility studies. Given the importance of the Al-Furat Company and its long years of operation, it seems unusual that the Company has not yet developed this capability.

Feasibility studies are undertaken in various ways. In Egypt, the companies do not prepare these studies alone, but rather jointly with national organizations or jointly with national organizations and foreign companies. This again reflects the trend in Egypt for developing strong national organizations which assist the manufacturing establishments and bear the responsibility for specific functions such as this one. In Algeria, the situation is different and it is mainly the companies themselves that undertake this function. If the response to our questionnaire is representative of the situation in Algeria then the absence of technological capabilities at the level of national organizations indicates a real weakness. As for Tunisia and Morocco, different modalities exist. In the Syrian Arab Republic, the Al-Furat Tractor Company stated again that it relied completely on foreigners to undertake this function. One last comment to be made here is that there is no problem in engaging a reputable foreign consultancy firm to do feasibility studies as long as the local company and/or a national organization are also involved in this exercise. To insist otherwise is unrealistic because the local staff are not familiar enough with the new technology and its implications. On the other hand they should be able to prepare themselves feasibility studies on expansion of existing production capacities.

- Engineering is undertaken with or without foreign participation. 56% of the companies that answered our questionnaire reported that they either undertook this function alone (majority of cases) or jointly with national organizations, or that those organizations alone do the engineering. Except for one company, the rest indicated that they needed foreign assistance to augment their own efforts. Only the Foundry and Mechanics Company (SOFOMECA) in Tunis, reported that it relied completely on foreign capabilities to undertake this function. This is a weakness which ought to be rectified by insisting that the foreign company involve and train nationals on this function.

- Factory design is undertaken either by the companies or by relevant national organizations but without foreign participation in 30 per cent of the cases. In other cases the foreign company collaborates with the local companies or the national organization or both in making the factory designs.

However in two companies, SOFOMECA in Tunisia and Al-Furat Tractor Co. in the Syrian Arab Republic, factory design is undertaken completely by the foreign party. This situation, as was mentioned in the case of engineering, ought to be corrected.

- Construction is predominantly undertaken by specialized national organizations or companies. For 73 per cent of the companies this is done exclusively by those organizations or companies. However, 13 per cent of the manufacturing companies stated that they also participated in construction (STEELCO and SIMAF in Egypt and CHAKIRA in Tunisia). Only in limited cases was foreign participation needed, presumably for complicated projects. The lack of this capability at the manufacturing establishment level is normal, and is better left to specialized national consulting companies and contractors.

- Product design is undertaken completely by 10 manufacturing establishments out of 23 which provided information on this matter. For two manufacturing establishments this is undertaken by them jointly with national organizations. Yet for another two companies, national organizations do the product design for the manufacturing establishments. For 10 other manufacturing establishments, product design is undertaken by them in collaboration with foreign companies and sometimes with national organizations as well. For two companies, the Steel Structure Co., in Algeria and Al-Furat Tractor Co., in the Syrian Arab Republic, product design is done completely by a foreign company. From the above discussion it is evident that there is a general basic weakness in product design in the Arab capital goods and engineering industries, because every manufacturing establishment should develop its own capabilities for its total needs in product design. In other words, reliance on a foreign partner or company on this function should be gradually reduced according to a time plan.

- Process design is undertaken completely by seven out of 22 companies that answered our questionnaire, whereas 13 other companies reported that they have undertaken this function with the assistance of foreign companies. For one company, the Industrial Company for Electric Equipment (SIAME) in Tunisia, this function is undertaken totally by a foreign company. The above indicates strong reliance on foreign companies in this basic function. Like product design, each manufacturing establishment should develop total internal capability in process design in due time.

- Maintenance is undertaken completely by 11 companies out of 21 that provided information on this subject, and by another two companies jointly with national organizations. On the other hand, nine companies, or 43 per cent, reported that they did maintenance work with the assistance of foreign companies. This is another major weakness in a crucial function, and surprisingly enough five out of seven Egyptian companies fall in this category. Like product design and process design, each manufacturing company should develop total capabilities in maintenance.

- Manufacture of spare parts: Ten companies reported that they relied on their own capabilities for manufacturing the spare parts they needed, whereas nine others indicated that they needed foreign assistance. The above statements ought to be taken with reservations, for it is more likely that the 10 companies mentioned above manufacture only some parts. In general, it is

safe to say that Arab manufacturers still rely heavily on importing spare parts for the repair and maintenance of their equipment. Again, this function should be undertaken entirely at the manufacturing establishment level, except in obvious situations when a major part of equipment goes wrong. The development of capabilities in this function goes hand in hand with the development of maintenance capability.

- Research and development has been undertaken by many manufacturing establishments under analysis. In addition, many of them rely also on national capabilities and/or foreign capabilities. The study reveals that R and D has been the subject of concern in various countries and that attempts have been made to strengthen it at the plant, industry and national levels. However, more efforts are needed in that direction especially with respect to foreign, formal and strong linkages among the research institutions and between these institutions and the manufacturing establishments. The reliance by some manufacturing establishments on foreign capabilities is not surprising in view of the situation in product design, process design, maintenance and other key functions. It would have been surprising if those establishments reported otherwise.

- After-sales services: 82 per cent of the companies that responded to our questionnaires reported that they undertook these services alone, whereas the rest stated that they relied partly on foreign assistance. Examples of the latter include the Boiler and Pressure Vessels Co., in Egypt, the Industrial Hydromechanic Co., (Hydromeca) in Tunisia, and CGE in Morocco. In general the above information indicates satisfactory development of this technological capability which is an essential element in selling the product.

- Marketing is undertaken by the manufacturing establishments themselves in most cases. Eighty-one per cent the companies that responded to the questionnaire stated that they undertook this function alone, whereas the others undertook this function in conjunction with a foreign company. The above indicates that, similar to after-sales services, significant progress has been made in developing marketing capabilities in the Arab capital goods and engineering industries.

- Training: Not one company out of the 23 that answered our questionnaire reported that it undertook this function alone. Only three manufacturing companies reported that they trained their personnel jointly with national organizations (training centres). The remaining 20 companies did so in collaboration with foreign companies (mainly the sources of technology) and in most cases in co-operation with national training centres. From all indications it seems that the Arab countries have given training a great deal of emphasis. Yet it is evident from the assessment of present capabilities that the competence of the local work force has not improved proportionately. This result needs further investigation and could be attributed to many factors including migration of trained workers to better paying jobs, mismanagement and lack of incentives, lack of co-operation on the part of the foreign partner, etc.

Technological capabilities, as seen from the preceding discussion, encompass four levels:

- The plant level, where capabilities exist in various organizational units of the manufacturing establishment;

- The industry branch level where the manufacturing establishment interacts with specialized R and D institutes and laboratories, training centres, consulting and engineering organizations, feeding industries and other manufacturing establishments within the sector.

- The national level, where the manufacturing establishments interacts with the universities, vocational schools, contractors, ministries, and other national institutions.

- The regional level where the manufacturing establishments are regional, or where regional organizations concerned with the development of technological capabilities interact with one another and with country situations. Examples of such regional organizations include various international and Arab organizations working in the Arab countries. The regional level has been insignificant in the past because regional industrial co-operation and integration has been developing slowly.

In the future, the technology of capital goods and engineering industries will undergo changes that will be caused by new developments in the technologies of end-use products, new designs and production processes that would reduce costs, and new applications in the microelectronics and other dynamic industries. However, the technology will remain basically stable in the sense that the expected innovations will not render absolute the technological capabilities developed so far. A process of evolution is envisaged for the future.

5.2 Recommendations

1. Formulation of technology policies

Each government should formulate a national technology policy (NTP) which involves carrying out essential responsibilities such as the planning, budgeting, management, co-ordination, stimulation, promotion and execution of technological activities relevant to the development objectives. In this context, NTP should be used as a major instrument of development.

The NTP should tend at least to realize the following objectives:

- Stimulation of the national technological capabilities to increase their inputs and the inputs from foreign sources both qualitatively and quantitatively through strengthening of the local innovative-adaptive-productive capacities, and co-ordinating their inputs.

- Rationalization of the flow of foreign inputs with a view to creating a socio-economically favourable balance with inputs from local sources, particularly with regard to technological inputs, goods and services and capital investments.

The realization of these two objectives simultaneously requires the ability to maintain a dynamic equilibrium, in which the inputs from indigenous and from foreign sources are balanced; it also requires that efforts be made continuously to shift the equilibrium increasingly in favour of the country's technological development. The guiding principle is to work progressively towards substituting local generated technologies for imported technologies.

The formulation of the NTP would inevitably have to provide explicit pronouncements on a number of issues which affect the national peformance by stimulation of the national inputs and rationalization of the foreign inputs, all to the advantage of the technological development of the country. These issues are seen to comprise the following:

(a) For the stimulation of national inputs:

- Strengthening of the national science and technology institutional infrastructure.

- Stimulation of demand for the services of the national R and D establishment.

- Improvement of the organization and management of R and D institutions.

- Orientation of activities in R and D institutions towards applied research.

- Provision of adequate financing for R and D activities.

- Creation of some centres of excellence in science and technology.

- Popularization of science and technology.

- Development of managerial capacities in research and development and technology in all its facets.

- The establishment of a national capacity for assessment, selection, acquisition and adaptation of foreign technology and expertise taking fully into account prevailing economic, social, cultural and environmental conditions.

- Promotion of communication and co-operation among government agencies, research institutions, professional societies and technology users and preferably undertaking joint projects by all these organizations.

(b) For the rationalization of foreign inputs:

- Creation of institutional and legislative arrangements for the rationalization of foreign inputs affecting technological development.

- Optimization of the utilization of foreign scientific relations.

It is necessary for each country not only to formulate an NTP but also to ensure that this will be fully integrated into the overall process of

economic and social planning. Thus, the technology components should be included in national development plans and strategies for the national, sectoral, intersectoral and project levels.

The NTP should incorporate a clear general national position regarding the required levels of technology from foreign sources, because the spectrum of technology is very broad and ranges from the most simple to the most advanced technologies. The general national technological position should be derived from the local conditions of the concerned country, in the first instance from the size and quality of the labour force, the availability of financial funds allocated to technology transfer and the size of the market.

The NTP should include a law regulating the transfer of technology. It should make illegal any contract which includes terms and conditions counter to the development of technological capabilities. Such cases may include:

- Importing technologies that are available locally.

- Prevention of importation of complementary technologies from other sources.

- Withdrawing technical documents by the foreign partner or licensor at some stage.

- Purchase of parts and components exclusively from the source of technology.

- Use of locally generated patents and inventions at no cost.

The components of the NTPs of the various countries should be compatible with one another in order to facilitate regional co-operation in the development of technological capabilities. The co-ordinating role could be assumed by Arab regional organizations, e.g., AIDO. In due time a Regional Technology Policy (RTP) will have to be formulated.

2. Building up of appropriate technology institutions

The NTP, in order to be fully effective, would have to rest on the solid foundation of a functional institutional structure, operated by trained manpower with diversified expertise, supported by adequate financial resources and coherent legislation.

The technological bodies concerned should have at least the following functions.

- To formulate, promote and monitor the implementation of the NTP.

- To mobilize and secure funds and allocate them to the various science and technology institutions in the light of national development priorities.

- To co-ordinate the activities of Science and Technology institutions and ensure close linkages with the manufacturing sector and promote the undertaking of joint R and D programmes and projects.

- To evaluate the social and cultural aspects of technology transfer and innovations.

- To promote regional and international co-operation in matters of technology transfer.

- To improve the working conditions of scientists and technologists with provisions for incentives so as to contribute to the solution of the brain drain problem.

- To advise local education and training bodies and make projections for building up human resources for technology development.

Within each country, the establishment of appropriate institutional structures should be made at three levels:

(i) At the national level:

- National planning integrated units for formulating and evaluating the NTP.

- National Information and Documentation Centres whose responsibility should include collecting scientific and technical documents in central national libraries, publishing of periodicals, research reports and studies in various fields of science and technology, and users services. Due to the vast and tremendous amount of information accumulated in various fields of Science and Technology, it is impossible to deal with such huge amounts of data by conventional methods; hence computerization of these materials becomes a must. Hundreds of data bases in different countries and covering all branches of Science and Technology are available and accessibility to these data bases is made feasible through modern telecommunication facilities (telephone, telex, satellite, etc.).

- Centres for evaluating and recording technology transfer contracts. All contracts should be approved by these centres before they become valid. The objective is to ensure that imported technologies are compatible with the needs, conditions and real interests of the countries concerned.

(ii) At the sectoral level:

- Specialized institutions in consultancy, design, engineering pre-investment and feasibility studies, and management.

- Technological information networks.

- Metrology, standardization and quality control agencies.

- Sectoral research and development centres.
- Sectoral training centres.
- Design, prototype construction, testing and advanced training centres
- Extension service centres.
- Centralized critical process centres.
- Heat treatment, precision machining, sintered material components etc.
- Tool rooms.
- Specialized industry/process research institutions, welding research, machine tool research institutes.

(iii) At the enterprise (plant) level:

- Techno-economic studies unit.
- Engineering unit.
- R and D units.
- Quality control units.
- Maintenance unit.
- Marketing and sales unit.
- Training units.

3. Strengthening regional and international co-operation in the field of technology

The following measures should be undertaken:

(a) Supporting the pan-Arab institutions such as AIDO, specialized Arab federations and Arab funds and making use of the services offered by these institutions;

(b) Exchange of expertise;

(c) Strengthening the technological information networks within the region;

(d) Making effective use of the services offered by the regional organizations of the United Nations such as ESCWA. These services are in the form of studies, advisory services, training services, seminars and expert group meetings.

(e) Establishing direct linkages between the local and foreign technical information networks;

(f) Establishing co-operative arrangements between local and foreign R and D centres;

(g) Participation in international technical exhibitions;

(h) Making effective use of bilateral and multilateral technical assistance;

(i) Making effective use of the services offered by the specialized technical agencies of the United Nations like UNIDO and UNDP.

4. Development of specific technological capabilities

(a) Selection of technology and its source

The first and foremost activity in the transfer of technology is the selection of technology and its source. The selection of technology should be based on the following criteria:

(i) Preference should be given to the more advanced technology which has no economic or social disadvantages. Technologies which are in their way to obsolescence should not be considered.

(ii) The technology should meet the following conditions:

- It should encompass valid invention patents.

- It should have been used and found acceptable, especially in the advanced developing countries such as the Republic of Korea, India and Mexico.

(iii) Only those elements of the foreign technology which cannot be provided locally should be imported. This means that turnkey arrangements should not be made because it is not possible to depackage their technology and examine its elements, e.g. technical know-how, services and manpower skills.

(iv) The role of the technology in adding to the local resources and capabilities with respect to technical know-how, training of staff and utilization of raw material requires close examination of all elements of the technology.

(v) It should save on the consumption of energy.

(vi) It should have little negative effect on the environment.

(vii) It should offer large employment opportunities.

(viii) It should be the least costly, especially with respect to its foreign components.

The selection of the source of technology should be based on the following considerations:

(i) Preference should be given to the local source. Whenever it becomes necessary to solicit the assistance of a foreign source this should be done in conjunction with a local source in order to develop local capabilities.

(ii) In the case of a foreign source of technology, preference should be given to those who are willing to offer the sort of technical assistance mentioned above including depackaging of technology.

(iii) The reputation of the source of technology should be considered.

The above activities require continuous availability and updating of detailed information at sectoral data banks that are linked to specialized international and regional banks and to banks in advanced countries. The information required can be assimilated by respective recipients, e.g., R and D units.

(b) Negotiations of contracts

In order to ensure a smooth transfer of technology and subsequent absorbing and adaptation of the imported technology and creation of local technologies, it is important to conclude technology contracts which require the foreign companies to do the following:

(i) To assist in establishing local design and research capabilities for modification of original designs or making new designs more suitable to local conditions;

(ii) To assist in establishing local capabilities for designing jigs, tools and other production needs;

(iii) To assist in introducing comprehensive planning and monitoring systems as well as an inventory system and a maintenance plan to ensure smooth operations in the plant;

(iv) To assist in inspection and quality control operations to bring up the quality of the local product to that of its foreign counterpart;

(v) To help the local manufacture of parts and components including castings and forgings, either at the plant or at feeding industries. The foreign company should be obligated to provide all technical assistance to the local feeding industries.

- To assist in formulating a comprehensive plan, including a timetable, for increasing the percentage of local manufacturing at the plant;

- To allow the local company to import parts and components directly from their manufacturers and not through the foreign partner;

- To undertake necessary training of local personnel to reach the level which will enable them to carry out the above activities.

Negotiation of contracts should be the responsibility of the national entity which undertakes the selection of technology, and its source.

(c) Preparation of pre-feasibility and feasibility studies

Each manufacturing establishment should develop internal capabilities to undertake techno-economic pre-investment (pre-feasibility) studies. The situation is different with regard to feasibility studies. In this case the required capability should be developed within specialized sectoral and/or national institutions, and not necessarily within the manufacturing establishments. Those institutions, in turn, will be able to train the staff of the manufacturing establishments on the preparation of pre-feasibility studies. One possible measure to enhance capabilities in preparation of feasibility studies is to insist on foreign consulting firms to utilize some local staff when undertaking such assignments.

(d) Engineering, and factory design

The role of consultancy services in developing technology, including engineering, needs to be strengthened and tailored to the needs of the industry. As an operational capability, engineering has top priority. For that reason it is proposed to establish sectoral and national consulting capabilities to conduct comprehensive and integrated studies on "total projects". As such, each consultancy organization should be both interdisciplinary and specialized in one of the industries concerned: engineering, electrical, electronic, automotive, plastics, etc.

In the process of establishing these capabilities, it is important to utilize existing consulting offices, and possibly strengthen them to the required level. It is also recommended that legislation be introduced to oblige foreign consulting companies to engage local consulting organizations as partners whenever they conduct any study in the region. It should be mentioned that even in the long run such associations with foreign consulting companies could be beneficial to the region as long as local capabilities are developed as a result.

(e) Process and product design

These operational activities must be completely undertaken by the manufacturing establishment. The building up of local capabilities in process and product design should be a condition stipulated clearly in any technical assistance, licensing, or joint venture agreement. Given the complexity of these functions, this process will be gradual; however, a timetable should be devised for controlling and monitoring the development of local capabilities.

(f) Construction

These capabilities should be developed at national design centres and contracting companies. In order to enhance the competence of these centres and companies, the respective governments may insist that foreign contractors subcontract a certain percentage of their work to local designers and contractors.

(g) Maintenance, quality control and manufacture of spare parts

As operational capabilities, maintenance and quality control are activities whose development should be given top priority by the manufacturing establishment, since without proper maintenance production ceases, and without proper quality control the products will not be competitive in the market.

The manufacturing establishment should be able to maintain its equipment and facilities completely by its own efforts and capabilities. It should also be able to make most repairs and manufacture the respective parts internally. Only for the very specialized repairs or parts should the manufacturing establishment depend on local organizations or foreign companies.

The importance of maintenance and quality control should be reflected in the process of selecting the source of technology and negotiating the contracts. The foreign company should be required to train and develop local personnel to maintain production machinery and equipment and undertake quality control checks to the level of complete self-reliance in accordance with a plan of action including specific timetables.

(h) Research and Development (R and D)

The type of research directly related to this study is applied research i.e., developmental research whose objective is to develop, improve and strengthen the outputs of the manufacturing establishment (products, services, etc.) and its operations (production, maintenance, etc.). Applied research is thus an important activity which every manufacturing establishment must pursue. The R and D capabilities come into the picture only when or after production starts. As a preliminary to R and D the subjects to be investigated need to be identified.

In contrast with pure research which is normally carried out by national institutions (e.g., universities) and which does not have to be carried out in the facilities of its end users, applied research capabilities should be established at the plant level. Each manufacturing establishment should have its own R and D facilities which can satisfy almost all of its needs.

The main functions of the R and D unit in the manufacturing establishment should be the following:

(i) To develop the industrial systems to become compatible with industrial economies, e.g., through efficient utilization of local raw materials and parts instead of importing them;

(ii) To assist production units to carry out their tasks;

(iii) To co-operate with the feeding industries which supply parts and components;

(iv) To co-operate with other sectoral and national research centres, e.g., specialized R and D centres, universities, etc;

(v) To assist in selecting technologies for expansion and new projects.

In order to enhance these R and D units it is proposed that:

(i) R and D units should be equipped with modern and necessary facilities, e.g., computers.

(ii) A certain percentage, i.e., 6 to 10 per cent of the manufacturing establishment's budget, should be allocated to R and D.

(iii) Incentives, including raises in pay, should be introduced to prevent migration of talents.

(iv) R and D units should be given the status they rightly deserve and be considered one of the criteria used in evaluating the performance of their manufacturing establishments.

Of course there are cases when R and D activities can best be carried out for the manufacturing establishment outside its facilities. Examples of such cases are:

(i) During the initial phase of operation of the manufacturing establishment when priority is given to production.

(ii) In specific fields which infrequently concern the manufacturing establishment and for which it will be costly to provide the required facilities and capabilities within the establishment. In such cases, sectoral research centres can best do the job: one example is the Alloys Research Centre in Egypt and the building material laboratory of the Royal Scientific Society in Jordan. On the other hand, there should be no duplication of efforts between R and D at the plant and R and D at sectoral or national levels.

Regarding sectoral R and D capabilities, it is suggested that more research centres and specialized laboratories be established according to specialization. The functions of such centres should include:

(i) Assisting R and D units within the manufacturing establishments to evaluate and select the appropriate technology, and to solve problems within the centres capabilities, e.g., welding methods, etc.;

(ii) Training staff of R and D units.

Concurrently, it is proposed to modernize the facilities of these centres and to introduce a system of incentives for their staff as some measures for strengthening them.

As for national R and D capabilities, it is necessary to strengthen applied research within the university and other national institutions by making it responsive to the needs of industry.

Annex I

CASE STUDIES

I.1. Nasr Automotive Company (NASCO) in Egypt

The Company was established in 1959, and production started in 1961. It is located in Cairo, and its ownership is 100 per cent public sector. The paid-up capital is 63.5 million pounds and the invested capital is 22 million pounds.

The main products are:

(1) Medium and heavy lorries.

(2) Medium and heavy buses.

(3) Cars.

(4) Trailers.

(5) Tractors.

(6) Diesel engines.

No information is given about the designed capacity of these products except for the capacity of the medium and heavy buses which is 4,900 buses per annum. The actual production of these products for the year 1983/1984 was 3,350, 750, 23,835, 400, 3,500 and 581 units respectively.

The sales value of these products in the year 1983/1984 was:

(1) 87.3 million Egyptian pounds for 3,198 all-size lorries.

(2) 36.6 million Egyptian pounds for 693 buses;

(3) 24 million Egyptian pounds for 4,193 agricultural tractors;

(4) 804,000 Egyptian pounds for 192 trailers;

(5) 101 million Egyptian pounds for 19,033 cars;

(6) 581,000 Egyptian pounds for diesel engines.

The total sale value was 256 million Egyptian pounds. No information is available about the export of these products to the Arab or foreign markets.

The number of employees of the Nasr Automotive Company in the year 1983 was 11,275, all were local. Almost 6,000 were skilled workers: 24 in managerial administration posts, 39 general managers, 219 managers, 221 heads of departments, 2 chemists, 6 scientists, 1 mathematician, 194 engineers in various fields, 571 economists, 3,876 with industrial diplomas, 531 with trade diplomas and 560 with below average education; the remaining 5,000 employees were non-skilled workers.

As important as is the strengthening of capabilities within the respective R and D centres, it is important to formulate formal linkages for co-operation and co-ordinating between the manufacturing establishments and the sectoral and national research centres. To ensure proper interlinkaging it is proposed that:

(i) The boards of directors of the specialized research centres and the boards of trustees of universities include representatives of the major manufacturing establishments;

(ii) The work done by the specialized research centres and the universities for the benefit of the manufacturing establishments should be performed on a commercial and businesslike basis, and the R and D centres concerned should endeavour to make the compensation therefrom an appreciable part of their income.

(iii) The R and D activities at the sectoral and national levels should be specialized and different from R and D work at the plant level.

(i) After-sales services

Because this capability is essential for marketing the product and making it competitive with respect to its foreign counterpart, special efforts should be made to develop it at the manufacturing establishment level. As was mentioned previously, specialized units within these establishments should be set up for this purpose.

5. Preparation of master plans for development of technological capabilities

In order to utilize the findings and results of this study for strengthening of local technological capabilities, it may be necessary for each government to prepare, within this framework, its own master plan for developing its technological capabilities in accordance with its particular technological needs and socio-economic conditions. Once the national master plans are developed, it may be possible to integrate them into a regional or Pan-Arab master plan, or at least to co-ordinate them.

The major expansion in the industrial units expected to be implemented in the next five year plan includes the following:

(1) Car production at a cost of 145 million pounds;

(2) Development of lorry and bus production at a cost of 65.5 million pounds;

(3) Development of agricultural tractors production at a cost of 30 million pounds;

(4) Replacements and alterations, at a cost of 45 million pounds.

The total comes to 285.5 million pounds.

The various activities concerning technological capabilities are undertaken with different sources. The Company performs the pre-feasibility studies itself. The feasibility studies are undertaken jointly by the Company and the General Manufacturing Organization, the Ministry of Defense and the licensing companies. Plant design, engineering design, product designs and production planning are dealt with by foreign licensing companies. Civil and construction work is undertaken by consultancy companies and contractors with no assistance or supervision from the Company. The marketing and maintenance companies assist the Company in maintenance, sales and customers services. Research and development is undertaken by research centres and by the Company itself.

The Company has achieved some progress in producing some of the required spare parts. The Company's products are final products; therefore they are not used as inputs or intermediary products except in certain equipment such as electricity generators. On the other hand car spare parts are utilized as intermediary products in cars and trailer maintenance workshops.

The Company has assisted in establishing certain car maintenance projects, and bus and tractor design projects as a means of co-operation with consumer companies. Co-operation of this type has strengthened and developed technological capabilities especially in the field of design, which has improved production quality.

As a means of producing intermediary products the Company has assisted in implementing the National Youth Company for car maintenance, the Arabic-American company for car manufacturing, and a furniture company. There is also co-operation with local companies in order to develop the required intermediary products to a certain quality level compatible with the international market standards.

The Company has been able to resolve the main obstacles and technological problems that it has been faced with by continuous co-operation with local companies, especially companies that manufacture intermediary products, and by establishing non-centralized units for maintenance and training its staff in or outside the country. The quality control and inventory control functions are continuously evaluated and improved.

Dependency upon foreign companies has become less for the Company; it has absorbed the technology and developed it accordingly by continuous training of its personnel. Training takes place in the following:

(1) The Company itself, which offers training in technical, managerial and supervisory fields;

(2) The country (universities - research centres - training centres) that offer training for special research and industrial management.

(3) Specialized training centres outside the country. These centres offer training in design, technical and managerial fields;

(4) Companies with similar activities outside the country. These companies offer training on apparatus and equipment, and also on design and development.

The main project which has been implemented in the past five years is the annual renewal of the contract which was first signed in the 1960s for manufacturing lorries, buses, cars, tractors and trailers. As was explained, the selection of technology is decided by the Company itself, the General Manufacturing Organization and the Ministry of Defence (Armed Forces). The main sources of technology have been the following:

(1) Kellogs - Federal Republic of Germany - 1959 for lorries and buses manufacturing.

(2) FIAT - Italy - 1961 - for car manufacturing.

(3) IMR - Yugoslavia - 1961 - for agricultural tractors.

(4) POLON - Poland - 1971 - for car manufacturing.

(5) Blumhart - Federal Republic of Germany - 1961 - for trailers manufacturing.

All agreements with these companies are based upon patent licensing and technical assistance.

There are certain constraints on the Company such as restrictions on the transfer and development of technology inside and outside the country. There are also restrictions on exports to certain countries. Quality control is dealt with under the utmost confidentiality. Buying and utilizing intermediary products is subject to certain restrictions and so is the training of personnel. The duration of the agreements with the foreign companies is five years. The only non-restricted areas are sales and prices. There is also a major obstacle in acquisition of technology which is the length of period needed to finalize the agreements.

Certain recommendations are suggested by the staff of the Company to improve its operation:

(1) A national organization should be established to formulate the rules and policies concerning technology transfer and to ensure that all concerned adhere to it. The rules and policies must take into account the Egyptian circumstances.

(2) All contracts must contain a clause indicating that new products will be developed, and that technical assistance should be available to develop feeding industries to help local production.

(3) A plan should be implemented whereby all technological centres and establishments are obliged to work towards industrial development.

(4) The solution of certain technological problems should be undertaken by university research.

(5) Incentives should be developed to discourage the migration of skilled people.

(6) Emphasis should be placed on training technical personnel in the field of computer applications in order to develop production.

(7) The widespread use of technology and its applications should be encouraged.

I.2. The Egyptian Company for Railway Equipment (SIMAF)

The following information describes SIMAF in brief:

Establishment date: 1957. Production date: 1960. Location: Ein Helwan, Cairo. Ownership: 100 per cent public sector. Invested capital: 2.8 million Egyptian pounds. Paid-up capital: 16 million Egyptian pounds.

The actual production of the four main products in this company for the year 1983/1984 was as follows:

(1) 111 Passenger wagons

(2) 828 Freight wagons

(3) 10 Tram wagons

(4) 121 Renovated wagons

The sales value of these products is as follows:

(1) 10 million Egyptian pounds for 111 passenger wagons

(2) 32 million pounds for 828 freight wagons

(3) 3 million pounds for 10 tram wagons

(4) 3.7 million pounds for 121 renovated wagons. The total was 49.6 million Egyptian pounds for 1,070 products in the year 1983.

Employment in this company is totally local, and the total of 1,040 employees in the year 1983 was divided into two categories:

(1) 1,972 skilled workers who were employed according to their educational level as shown below:

- 14 Managerial administration posts
- 227 Managerial posts
- 1 Scientist
- 1 Mathematician
- 3 Electrical engineers
- 22 Mechanical engineers
- 1 Electronic engineer
- 1 Other engineering specialization
- 533 Industrial diploma holders
- 169 Trade diploma holders.

(2) 169 unskilled workers.

The Company possesses capabilities for dealing with many technological activities on its own such as pre-feasibility studies, product design, process design, marketing, maintenance, consumer services and most of the factory

designs. GOFI and the Railway Agency assist the Company in conducting feasibility studies. The engineering design and construction work is carried out by various offices. Half of the responsibility of Research and Development operations is assumed by the Academy of Scientific Research and Technology, while the other half is the Company's responsibility. The Company is capable of manufacturing many of the spare parts needed for some of its own products such as the tram and railway wagons. It is also capable of producing spare parts for some of the imported railway wagons. The Company's products are used by the Railway Organization and General Transport Organization.

The Company maintains continuous co-operation with the industry by developing its planning and designing capabilities; The Company has even sold these designs to European countries, to use in their railway wagon manufacturing. There is also continuous co-operation between the Company and the raw material and feedstock producers in order to develop their materials according to international standards. The Company also sends permanent supervisors to inspect and supervise the process of raw material manufacturing, and assist in any of the problems which may arise.

The obstacles which the Company was faced with and was able to overcome were maintenance, absorbing the technology used and quality control. All three problems were solved by continuous training inside and outside the Company, and also by employing foreign trainers and experts, which leads to the conclusion that the Company needs and depends on foreign expertise.

The training programme in this company takes place in four different places according to the training programmes offered:

(1) The Company itself, which trains technicians, university students, foreigners and industrial students;

(2) Inside the country (universities, training centres, research centres, etc.); training is offered in technical and managerial matters, computer programming and languages;

(3) Outside the country (specialized training institutions, stipends for various types of training);

(4) Outside the country (companies with similar activities), with training programmes for production process, designs and quality development.

The main project which the Company implemented in the past five years was manufacturing train wagons. The Egyptian Railway Organization and the General Transport Organization are in charge of the evaluation and selection process. The selection of technology is influenced by the following:

(1) Technical factors

- Ability to absorb the technology
- Availability of raw materials
- Type of manpower required
- Operating and maintenance requirements.

(2) Economic factors

- Availability of sources of finance.
- Return on investment.

(3) Selection of technology sources:

- Reputation of source and its products.
- Suitability of contract terms and conditions along with the guarantees offered.

There are two main sources of technology the Company depends upon: the first, which is local, is the Academy of Scientific Research and Technology, while the second source is foreign; it is the Japanese Mitsubishi Company, and the Hungarian Janz Maffaj Company.

The basis upon which the Company acquires its technology is a patent licence basis with technical assistance to enable manufacturing of products and to improve the portion of local manufacturing, and also by offering some equipment and spare parts for assembly purposes.

The Company holds patent licences for transfer of technology with the following specific terms;

- To offer the new designs concerning new products.

- To offer the Company technical assistance in order to manufacture the products locally utilizing available local raw material that is approved according to international standards.

- Offering of some equipment which it is not possible to produce locally for reasons of economy.

There are certain restrictions in the contract concerning transfer of technology outside the country. Exports are also limited and forbidden to some countries. Quality is controlled according to international standards, technology is also restricted and not offered to everyone, especially not to competing companies. The contract also deals with matters concerning training of personnel whether inside or outside the country, and also buying of raw materials and feedstock which is not available locally. The duration period of the contract is normally five years.

The main fields which the company has developed or altered are:

(1) Developing third class wagons and producing two kinds of second class wagons; one is regular and the second is a hospital wagon. Both are air conditioned. The Company was able to produce these two second class wagons without any assistance whatsoever.

(2) Development of spark-plug production under supervision and assistance from the Hungarian Company Janz Maffaj. The spark-plugs were

developed to suit the Egyptian railway environment, to increase comfort, and to increase train speed.

The Research and Development matters are undertaken by the Company itself and the public sector Organization for Engineering Industries while evaluation and selection of technology rest with GOFI, the Railway Organization and the Academy of Scientific Research and Technology. The final decision makers are GOFI and the Ministry of Industry.

The main difficulties that face the Company are:

- Length of time required to make the final decision.
- Numerous rules and regulations governing the acquisition of technology.

Therefore the Company suggests simplifying procedures in order to quicken the pace of obtaining and implementing technology.

I.3. The Boiler and Pressure Vessel Manufacturing Company in Egypt

The Company's location is Giza, Egypt. Its invested capital is 5.3 million pounds; its paid-up capital is 9.5 million pounds.

The actual production of the three main products for the year 1983 was: (1) 52 boilers (1/2-2 tons); (2) pressure vessels and storage tanks; (3) other products.

The sales value of these products in the year 1983 was: (1) 2 million pounds for 52 boilers; (2) 474,000 pounds for pressure vessels and storage tanks; (3) 687,000 pounds for the other products. The grand total was 3.2 million pounds.

In 1983 employees according to nationality were all locals. Almost 300 of them were skilled workers, 3 were in managerial administrative posts, 16 managers, 188 were heads of departments, 10 were statisticians, 7 were electricians, 42 mechanical engineers, 4 electronic engineers, 2 chemists, 12 in other engineering specialities and 26 were economists; the remaining 600 were unskilled workers.

There is only one main project considered in the next five year plan and that is a joint project with the Stein-Muller Company for production development; another priority is implementing private projects in power stations, food factories and chemical industries.

The technological linkages related to the various activities mentioned in the survey are implemented by different organizations. The pre-feasibility studies and engineering designs are undertaken by the Company and by GOFI as well as foreign companies, such as the Federal Republic of Germany companies, (Babcock, Baumgart) and the Indian private consultant office. The Company is assisted in the construction works by consultancy offices. Product design is split into two categories, products which are designed by the Federal Republic of German company Stein Muller and products which are designed by the Egyptian company itself. The Company is also assisted in process design by foreign companies. Stein Muller also implements maintenance, research and development and consumer services, along with the Company. The Engineering College in Cairo University assists the Company with the required research and development work in this specific field.

The Company is capable of producing the spare parts required for its own products, while the spare parts required for production equipment are left mainly for other companies to produce except for a few simple parts which the Company itself can produce.

The Company's products are capital equipment used in textile factories, chemical industries and power generation stations, which means that they cannot be considered as feedstock equipment. The Company deals closely with these industries by developing its products according to customer standards and requirements and also by holding periodic maintenance reviews; this in turn helps to develop design capabilities in the Company itself.

Most of the utilized raw material is imported because the local raw material is not suitable and is sometimes dangerous. Migration of skilled workers is another problem that faces the Company. The Company tries to develop its products to reach the required standards by holding periodic training. The inventory problems which the Company suffers from are not related to raw materials but to the manufactured stock.

The Company is dependent on its foreign partners for training purposes, development of design capabilities and quality control. Training of personnel takes place in:

(1) The Company itself, which offers training in industrial education and operating programmes;

(2) In the country (universities, training centres, research centres, etc.) training is offered in management and economics;

(3) Outside the country (training centres), stipends are offered from some countries;

(4) Outside the country (companies with similar activity), especially the joint venture companies.

The authority which decides on different technological process alternates for the various projects are the Company itself, GOFI and the Public Sector Organization for Engineering Industries.

The main factors affecting selection of technology are:

(1) Technical factors such as absorption of technology, skills of required manpower, degree of product quality, availability of energy, capabilities in operation and maintenance.

(2) Economic factors:

(a) Availability of financial resources;
(b) Return on investment.

The reputation of the product and its producer are the main factors which concern selection of technology source, especially if the source has provided technology elsewhere, and assisted in establishing joint ventures, as well as suitability of the terms and conditions of the contract. Foreign technology is agreed upon a patent-licence and a joint venture basis.

The latest contract was signed in 1985 and consisted more or less of the same conditions as the previous contract with a certain emphasis on training of personnel and engineers in planning, quality control, maintenance, welding and operating machinery; acquiring special product designs is another factor the Company emphasized in the contract. Development of sales and customers services and offering of technical assistance in manufacturing were also mentioned and agreed upon.

There are certain restrictions in the contract which impede the Company in certain matters, such as transfer of technology whether outside or inside the country, and development of technology which is allowed only after the approval of the Federal Republic of Germany company.

Exports are another area which is restricted with regard to some countries. Quality is also a controlled matter and material is bought only if it meets the German company's specifications. Training is authorized and undertaken by the German company, as is the selection of workers. The contract duration is eight years.

Efforts are very limited up till now in developing or altering the technology used; in order to master the required technology the public sector Organization for Engineering Industries and GOFI deal with research, evaluation and selection matters, while the final decision is left to the Ministry of Industry.

The main difficulties which the Company encounters are:

(1) Length of time to get final decision.

(2) Numerous rules and regulations.

(3) Numerous decision-makers.

I.4. El-Nasr Company for Transformers and Electrical Products (ELMACO) in Egypt

Location: Cairo. Ownership is 100 per cent governmental. Capital is not mentioned. Production date was 1961. The three main products are: (1) Distribution transformers (113540 KVA); (2) Welding transformers, (200 units); (3) Shears (1565 units), but there is no information about designed capacity. The sales value for these three products in 1983/1984 were 11.7 million pounds, 129 thousand pounds and 885 thousand pounds respectively, which totals 12.8 million pounds. No information is given about exports either to Arab or foreign countries.

There were 847 employees in El-Nasr Company in 1983. All were local, 293 of them were skilled workers: 7 in managerial administration posts, 68 managers or heads of departments, 1 scientist, 15 electrical engineers, 7 mechanical engineers, 1 civil engineer, 11 other engineering specialties, 16 economists, 90 with industrial diplomas, 79 with trade diplomas or secretaries and high school graduates. The others, almost 500 were unskilled workers.

The main expansions in the industrial units expected to be implemented in the next five years are:

(1) Condenser project, at a total cost of 500 thousand pounds.

(2) Ceramic insulator and galvanized tower project at a total cost of 1.5 million pounds.

The technological linkages related to the various activities mentioned in the survey go through different channels. Pre-feasibility studies are undertaken by the Company itself while feasibility studies are undertaken by GOFI and the foreign partners. Factory designs and engineering designs are supervised and implemented with the co-operation of both Arab and foreign establishments such as the MISR Electricity Organization and the foreign partner. The Construction and Installation Works are accomplished by a local consultancy office. Foreign companies supervise product design and operations and also assist the Company in supervising production management, research and development, maintenance, and training of personnel. Customer services and sales services are the responsibility of the Company itself.

Production of spare parts is one of the main steps the Company will be pursuing in the next five years. Especially production of parts that are used as inputs in the Company's products. As for spare parts related to the factory's machinery, co-operation with other local companies fulfils that need.

The Company maintains close contact and continuous co-operation with the MISR Electric Organization for preparation of studies and research. Co-operation of this type helps to develop products and technological capabilities to the level demanded by the customers.

There are no future plans concerning utilization of the Company's products as intermediate products, and there are no plans for producing raw materials such as steel silicon alloys and metal forgings since they are available in the world market.

The obstacles and technological problems which face the Company are (a) unsuitability of some local raw materials; and (b) importation of all spare parts. Training takes place in the foreign partners' factory and experts are invited as participants in the transfer of technology. Quality control is maintained by continuous training and supervision. Inventory control is periodic and systematic.

There is great dependency on the foreign partners for technology transfer and many partners have been changed because they did not fulfil the relevant agreements.

Training of personnel takes place in the Company itself, which offers training in production and design and outside the country, in foreign companies with similar activities. Training is mainly related to production, design, quality control and the latest technological developments.

The authorities which decide on different technological process alternates for the various projects are the Company itself and the MISR Electric Organization. The factors affecting selection of technology are:

(1) Technical factors: technology absorption, availability of raw materials, employment requirements and quality control;

(2) Economic and financial factors: availability of financial sources, low cost of production and expected return on investment.

(3) Selection of the technology source depends on reputation of the source and its products in the market, and offering of suitable conditions which help technology absorption.

The final decision-makers in selecting technology are the Ministry of Electricity and the MISR Electricity Organization.

Some of the main problems facing the Company are related to weak local skills and national implementation abilities.

The French Transport F.T. Company is the main source of technology used by the Company on an industrial licence and patent basis.

Within the technology transfer licence agreement, the Company receives assistance in manufacturing new products, increasing production, and developing quality control. Studies, consultancies, technical assistance and training are provided.

The only restriction in the contract is its five year duration.

There are some areas where the Company has decided to make changes or initiate new developments such as the use of local raw materials. For that purpose, the Company has made contact with an Egyptian company which produces the raw material and required qualities of certain raw materials. This in turn helped to develop the producing company. Quality control is carried out by periodic inspections of products through all stages of manufacturing. As for the machinery used, it is chosen to suit the new products according to the most developed and international standards.

In order to master the required technology, the MISR Electricity Organization deals with research and development. The selection, choice and evaluate on of technology are undertaken by GOFI and the MISR Electricity Organization. The Ministry of Electricity is left with the authority to make the final decisions.

Major obstacles faced in acquisition of technology were length of period needed to finalize agreements, multiplicity of decision-makers and unavailability of needed financing.

The recommendations of the Company for improving transfer of technology are the following: (1) direct contact with the foreign sources by exchanging visits and views on the latest systems and machinery; (2) training of personnel in the foreign factories and inviting trainers for practical and technical training; (3) acceleration and simplification of financing procedures dealing with foreign currency.

I.5. The Machine Tools Manufacturing Company in Egypt

The Company was established in 1958. Production started in 1964. The Company is located in Ein Helwan, Cairo. Its ownership is 100 per cent public sector.

The actual sales and production of the main products for the year 1983/1984 were:

(1) 3.5 million pounds for various machine tools;

(2) 6.3 million pounds for bakery equipment;

(3) 2 million pounds for other assembled products.

They all make a total of 11.8 million Egyptian pounds, but no reference is made to exports, whether to Arab or foreign markets.

The personnel is totally local in this company and is divided into two categories:

(1) 2,065 skilled workers;
(2) 89 non-skilled workers.

The skilled workers are employed according to education level and acquired skills: 6 are in managerial administrative posts, 84 are managers and heads of departments, 1 is a mathematician, 6 are electrical engineers, 28 mechanical engineers, 3 electronic engineers, 2 production engineers, 15 are in other engineering specialties, 1,672 have industrial diplomas, and 248 trade diplomas; this makes a grand total of 2,163 local employees.

The main expansions expected to be implemented in the following five years are:

(a) Manufacturing of armoured boxes for machine tools, agricultural tractors and elevators;

(b) Mill and silo manufacturing;

(c) Construction equipment and construction material factories manufacturing;

(d) Textile manufacturing equipment;
(e) Agricultural equipment and machinery manufacturing.

The various technological activities are implemented by three main sources:

(1) The Company itself, which deals mainly with the pre-feasibility studies, maintenance, marketing, customs and sales services, and research and development;

(2) The local companies, which deal with the construction and engineering design work;

(3) Foreign companies, which assist mainly in product and process design and the feasibility studies.

Since the Company uses the backward integration system, it produces the spare parts for its products as well as the spare parts required for its own equipment. Since the Company's products are capital goods, they cannot be utilized as feedstock or input material; however, the Company is considering a plan for producing armoured boxes which could be used as input material in other industries.

Co-operation between the Company and the Ministry of Supplies is expected to help to develop and implement these industries and offer suitable solutions to specific industrial problems; this in turn develops the Company's technological capabilities.

The Company has overcome many of the major obstacles and problems which are liable to face such a company. Maintenance is supervised and periodic, training is relevant, effective and systematic, quality is controlled and held to international standards, inventory has been controlled through long-term contracts, migration of skilled workers has been limited by offering incentives and motivations, raw materials and spare parts are suitable and available locally, and the Company is in close and continuous contact with universities and research centres for advice on any problems.

Foreign expertise is utilized mainly to supervise the manufacturing of new products and to control their quality; in spite of the importance of this activity, it only equals 20 per cent of the Company's total effort, which shows that there is not much dependence upon foreign expertise.

Training programmes are one of the main priorities for the Company for both new and old-time workers. These training programmes are offered in different places:

(1) The Company itself, which offers training in design, computer programming, production planning, project implementation, welding and operations;

(2) Local universities, training centres and research centres which offer training in maintenance, design, management and machine control, and technical training;

(3) Foreign companies with similar activities: training is offered in design and operation of new and advanced equipment.

The automatic lathe manufacturing project and the automatic milling machine manufacturing project were the two main projects implemented in the past five years. The factors that affect evaluation and selection standards in the Company are:

(1) Reputation of the source of technology;

(2) The terms, conditions, and guarantees stipulated in the contract;

(3) Transport regulations;

(4) Marketing;

(5) Return on investment;

(6) Manpower;

(7) Absorption of technology used;

(8) Suitability of technology for local raw material;

(9) Environmental safety;

(10) Operation and maintenance;

(11) Low investment cost;

(12) Availability of financial resources;

(13) Availability of required equipment and machinery;

(14) Economical energy consumption.

The Company is mainly its own decision maker for whatever concerns its work although this is within the authority of the Ministry of Military Products. The main sources of technology are:

(1) Local engineering colleges, design and development centre and the iron and steel company;

(2) The Soviet Bromass Exports Agency, the German Foyer Company for lathe manufacturing and the German Ferz and Fledder Company, are engaged on a patent/licence basis.

The Company holds licences for technology transfer from three sources:

(1) The Soviet Bromass Export Agency whose contract stipulates that it must carry out the following:

(a) Assist in manufacturing new product;

(b) Assist in increasing production;

(c) Strengthen local manufacturing;

(d) Develop of product quality;

(e) Assist in exporting products;

(f) Train personnel;

(g) Import of machinery and equipment.

(2) The German Ferz and Fledder Company: the main stated priorities are:

(a) Co-operation in manufacturing of new products;

(b) Equipment supply and assembly assistance;

(c) Strengthening local manufacturing;

(d) Development of quality products;

(e) Utilization of local raw materials;

(f) Training of personnel.

(3) The Federal Republic of Germany Foyer Company for lathe production: its contract emphasizes the following:

(a) Co-operation and assistance in manufacturing new products;

(b) Increasing production;

(c) Increasing and emphasizing local manufacturing;

(d) Development of quality products;

(e) Assistance in exports;

(f) Training of personnel.

There are certain restrictions in the contract concerning transfer of technology, exports, proprietary and input materials. The contracts are subject to Egyptian law, and their duration is normally five years.

There are certain obstacles which restrain the Company from accomplishing its objectives and implementing its stated plans. They include:

(a) Length of time required to conclude agreements;

(b) Numerous rules and regulations;

(c) Convincing the consumer of the importance of transferring technology.

Therefore the Company suggests the following actions to overcome the above-mentioned constraints:

(a) Make use of the foreign information centres;

(b) Visit the specialized foreign exhibitions;

(c) Concentrate upon electronics industries and train skilled labourers accordingly.

I.6. The Engineering Projects for Steel Works (STEELCO) in Egypt

The following information describes the Company:

Establishment date: July 1961. production date: July 1961. Location: Kasr Al-Nile, Cairo. Ownership: is 100 per cent public sector. Invested capital is 2.9 million Egyptian pounds. Paid-up capital is 10.6 million Egyptian pounds.

The actual production for the three main products in the year 1983/1984 was:

(1) 16,593 tons of metallic and mechanical structures;

(2) Bus structures;

(3) Galvanized metals.

The sales value for these products in the year 1983 was:

(1) 11.8 million Egyptian pounds for the metallic and mechanical structures;

(2) 5 million Egyptian pounds for bus structures;

(3) 1.7 million Egyptian pounds for galvanized metals.

The main expansions in the past five years were as follows:

(1) A substitution and renovation project;

(2) Manufacturing of metallic towers;

(3) Manufacturing of high construction and bridge equipment.

The Company undertakes most of the required and necessary activities such as:

(a) The pre-feasibility and feasibility studies;

(b) Engineering designs;

(c) Factory designs;

(d) Process designs;

(e) Customer services.

This leaves certain areas, such as construction works, production design, marketing, maintenance and research and development activities in which the Company requires assistance from local consultancy offices and research centres.

The Company acquires its spare parts every two years in advance along with engineering designs for some of these spare parts to manufacture them locally.

Some of the Company's products such as the galvanized works and carpentry equipment are used by other establishments as feedstock, but most of the Company's products such as the metallic structures, mechanic works and bus structures are capital equipment which cannot be considered as feedstock.

Continuous and consistant co-operation between this company and the Electricity Organization takes place in order to develop product quality to higher standards. The Company also assists agents in designing and constructing towers. Co-operation of this type assists the Company in developing its products and design capabilities in order to reach the required standards.

There are no present plans for manufacturing parts, but there is co-operation with some Egyptian and foreign companies to implement joint projects.

The Company resolved the main obstacles it encountered, namely:

(1) Raw materials, which were revised according to certain standards to enhance their quality and suitability;

(2) Spare parts, for which a two-year inventory system was established;

(3) Maintenance, for which technicians were trained internally and externally, and experts employed;

(4) Technology absorption, for which engineers and technicians were trained in foreign companies and experts employed;

(5) Quality control, which was strengthened by internal and external training;

(6) Inventory control, which was strengthened by internal training;

(7) Immigration of skilled workers, which was compensated by training mainly in the country and within the Company.

Training programmes are implemented for both new and old workers as follows:

(1) The establishment itself offers training in operating and maintaining machinery.

(2) Inside the country (universities, training centres, research centres, etc.) training is offered in organization and management.

(3) Outside the country in companies with similar activities, training is offered in operating new machinery, management and supervision.

The main factors which affect evaluation and selection of technology in the Company are:

(1) Technical factors: absorption of technology, availability of raw materials, types of skilled labourers required, degree of product quality, energy resources, operation and maintenance, availability of equipment, and environmental factors;

(2) Economic factors: availability of financial resources, low cost of investment, low cost of production, return on investment;

(3) Selection of technology source: reputation of source and its products, suitability of terms, conditions and guarantees stated in the contract, assistance in absorbing and implementing the technology used.

The main sources of the technology used are the following foreign companies:

(1) Demag Company (Federal Republic of Germany).

(2) Kaltenback Company (Federal Republic of Germany).

(3) Addinghaw Company (Federal Republic of Germany).

(4) Mubea Company (United Kingdom).

The technology is acquired from these sources on a patent/licence basis and also by establishing joint ventures and providing the Egyptian company with the engineering designs.

The Company holds patent licences for transfer of technology in the following fields:

(1) Designs: the foreign source offers them;

(2) Licence rights: in the joint projects only;

(3) Selection of equipment: according to requirements agreed upon by the foreign source;

(4) Exports: to countries which do not compete with the foreign sources' exports;

(5) Prices: no restrictions;
(6) Research and development.

There are certain restrictions in the contract which concern the following:

(1) Transfer of technology to another source inside the country;

(2) Transfer of technology to another source outside the country;

(3) Exports are restricted to certain countries, but are allowed to the countries within the region under no restrictions;

(4) Quality control;

(5) Confidentiality and proprietary rights.

The contract duration ranges from 3 to 5 years and the contract is subject to Egyptian law. The main fields which the Company developed or altered are:

(1) Designing and manufacturing of structures;

(2) Manufacturing of high structures and metallic towers;

(3) Manufacturing of bridges.

The approach and procedure used in acquiring the technology are evaluated and selected by the Company itself with assistance from the General Organization for Industrialization (GOIC) and the Public Sector Organization for Engineering Industries.

The Company finds difficulties in selecting the suitable technology and also during the negotiations period with the technology source.

I.7. The Egyptian Company for Metallic Construction, (METALCO)

The following information describes the Company:

Establishment date: 1967. Production date: 1967. Location: 26 July, Cairo. Ownership: 100 per cent public sector. Invested capital: 2.4 million Egyptian pounds. Paid-up capital: 8.4 million Egyptian pounds.

The designed capacity for the three main products totals 32,000 tons of:

(1) Storage tanks.

(2) High bridges and towers.

(3) Slide doors.

The actual production of these products amounts to 26,000 tons at a sales value of 18,000 pounds.

The main expansion in the past five years was a computerized unit for sectional cutting.

The Company undertakes on its own many of the technological activities such as factory design, engineering design, construction works, production management and after-sales services. Assistance is solicited and offered by various sources in order to implement other technological activities, such as the pre-feasibility and feasibility studies which are implemented by the General Organization for Industrialization and two Federal Republic of Germany companies, Byner and Ferrostahl. Product and process design are also undertaken by these two companies. Maintenance is handled by the Company and the source of equipment. Research and development are undertaken by various sources besides the Company itself. They include the Metal Research Centre, the Welding Centre and the Iron and Steel Company.

The Company manufactures some of its spare parts, and since the Company produces iron structures, metallic constructions, towers, slide doors and frame sets which are all intermediary products, they are considered as feedstock for major projects. The Company is in close contact with its customers in order to meet their demands and requirements which differ from one project to another.

Co-operation and continuous contact such as referred to above have strengthened the Company's production and design capabilities. Ferrometalco is a joint project between the Company itself and Ferrostahl. It was set up for manufacturing small and large metallic structures.

The main obstacles that faced the Company were as follows:

(1) Suitability of raw materials: this was solved in co-ordination with the Iron and Steel Company and the raw material producing factories;

(2) Spare parts: a great number were supplied according to contract conditions and the rest manufactured locally;

(3) Maintenance: periodical and systematic maintenance checks are conducted. Sometimes assistance is sought from the foreign companies;

(4) The difficulty in absorbing the technology used is solved by continuous training internally and externally;

(5) Quality: this has been improved by using specific ultrasound wave detectors to detect welding faults;

(6) Skilled labourers' migration: this problem has been overcome by continuous training of newcomers;

The works which were implemented under foreign supervision included:

(1) Cement factories (Al-Kattaniya, Al-Amiriya, Tourra);

(2) Iron prefab buildings (Abu-Elfida project);

(3) Brick factory (Helwan, Al-Fayyoum, Beny Sowaif, Kenna Wadi Al-Nahroun);

(4) Ramses bridge and pedestrian bridges.

(5) High tower bridges.

The Company holds training programmes for both old and new employees. Training takes place in four places:

(1) The Company itself: training is held for welding, assembly works, and machinery operation;

(2) Inside the country (universities, training centres, research centres, etc.). Training programmes within these establishments are for detecting welding faults, designing and management;

(3) Outside the country (specialized training centres) which offer training in design and management;

(4) Outside the country in companies with similar activities.

Training is offered in operating and controlling imported machinery and equipment.

A major implementation in the past five years was a tower bridges manufacturing project; the various alternatives were also evaluated and selected by local experts from within the Company itself and from the General Organizations of Industrialization.

The factors that are considered when evaluating and selecting the technology are as follows:

(1) Technical factors: technology absorption - availability of raw materials - type of required skills - degree of product quality - energy saving, abilities in operating and maintenance - availability of equipment - environmental factor;

(2) Economic factors: availability of financing sources - low investment, low cost of production;

(3) Factors concerning source of technology: reputation of source and its products in the international market, financing or participation in capital, suitability of terms and guarantees offered;

Most of the technology used is from locally developed sources. Foreign expertise is required in large construction projects and the tower bridges. Therefore the "Byner Company" supervised most of the tower bridges manufacturing, while another company, Ferrostahl undertook the light and heavy metallic construction. This technology was obtained on a patent-licence and/or joint venture basis. The main factors emphasized in the contract concluded with the Byner Company are:

- Offering of technical assistance for tower bridges manufacturing;
- Increasing of both actual production and percentage of local manufacturing;
- Improvement of quality level;
- Utilization of local raw materials;
- Offering assistance in conducting studies and in engineering;
- Training of personnel.

The factors mentioned in the contract concluded with Ferrostahl are:

- Offering of necessary designs for all projects undertaken by Ferrostahl;
- Offering of technical assistance and means of production;
- Assistance in product design;
- Importing some of the equipment;
- Improvement of quality level;
- Utilization of local raw materials;
- Training of personnel;
- Management assistance.

The Byner Company works under a patent-licence contract, while Ferrostahl works as a partner in a joint venture. The main restrictions in the contracts deal with:

(1) Transfer of technology to a third party. This is allowed only after the consent of the foreign company.

(2) Export is another restricted matter for it is allowed only to certain countries which the foreign company agrees on.

(3) Product quality must meet specified standards.

(4) Confidentiality is emphasized.

(5) There are restrictions on using certain raw materials which could affect products quality and standards.

(6) Training is controlled in order to improve level of skills.

The Byner contract is renewed annually while the Ferrostahl's contract duration period is 25 years. Both contracts are compatible with Egyptian law.

The final decision making body concerning acquisition of technology is the Ministry of Industry. Investigation of technology and source is left to the Company itself. Evaluation and final selection is a matter dealt with by The Public Sector Engineering Industries Organization, and the General Organization for Industrialization.

The main difficulties that face the Company are the length of period used for selecting technology and source, the numerous rules and regulations, multiplicity of decision makers, and the unavailability of local expertise capable of choosing the suitable and required technology.

I.8. Al-Furat Tractor Company in the Syrian Arab Republic

The following information describes the Company:

Establishment date: 1974. Production date: 1974. Location: Aleppo, Syrian Arab Republic. Ownership: 100 per cent public sector, 75 per cent by The Syrian Arab Republicn Arab Republic and 25 per cent by Spain. Invested capital: 150 million Syrian pounds, paid-up capital: 89 million Syrian pounds. Total capital: 258 million Syrian pounds.

The actual production and sales value for the main products in the year 1983 were:

(1) Around 4,000 agricultural tractors at an actual production value of 196 million Syrian pounds; their sales value 209 million Syrian pounds;

(2) 379 pieces of agricultural equipment at an actual production value of 1.51 million Syrian pounds, their sales value about 1.15 million Syrian pounds;

(3) A foundry shop.

Employment in this company is totally local and consists of 945 skilled workers: 2 in managerial administrative posts, 114 managers, 5 chemists, 5 electrical engineers, 30 mechanical engineers, 1 electronic engineer, 1 civil engineer, 5 chemical engineers, 6 economists and 776 technicians.

The main projects for expansion expected to be implemented in the next five years are:

(1) A development project for agricultural tractors up to a 70 hp capacity;

(2) A project for manufacturing spare parts for cement factories;

(3) A project for manufacturing tractors of 45 hp capacity.

The main technological activities are undertaken by four main sources: the Indian consultancy office, local offices, Federal Republic of Germany companies and the Furat Company itself. The Indian consultancy office undertakes the pre-feasibility and feasibility studies, and also the factory designs. The local offices and establishments take care of the construction work and engineering designs. The German Cement Company is engaged in production planning, while the Furat company is left to deal with process designs, product management, sales, research and development, maintenance and customers services. The Company has very limited capacity for producing spare parts and has no immediate or future plans for developing capabilities in this field.

The main obstacles that the Company faced and solved were:

(1) Unsuitability of raw materials, especially the sand used in the foundry;

(2) Unavailability of spare parts in local markets;

(3) Difficulty in technology absorption, which was solved by internal training and employing foreign experts;

(4) Quality control by continuous technical training for the skilled labourers.

The Company conducts continuous training programmes in the following places:

(1) In the Company itself: training is offered for newcomers in foundry process and in production process and in quality control for the old skilled workers;

(2) Inside the country in training centres which offer technical training for skilled workers in such areas as operating lathe machines;

(3) Outside the country in companies with similar activities such as Motoreberica (Spain) and Sentrozab (Poland).

The main project that was implemented in the past five years was the completion of the Company's factories; and since the Company's factories were established by an agreement with the Spanish company Motoreberica, the Company did not have to deal with the usual evaluation and selection of technological activities.

The sources of technology used are, as mentioned above Motoreberica (Spain) and Sentrozab (Poland) which offer their technology on a turnkey, and/or a patent-licence basis. The patents licences deal with technical assistance and licence rights.

The main restrictions in the contracts refer to the transfer of technology which is not allowed outside the country, exports which are limited to certain countries, quality control, and confidentiality concerning documents, and technical plans. The laws the contracts are subject to, are Syrian laws, and the only major difficulty faced by the Company which needs to be resolved is the long time required to finalize contracts and agreements with sources of technology.

Annex II

FIELD WORK

II.1. Missions

Algeria, Bahrain, Egypt, Jordan, Kuwait, Morocco, Saudi Arabia, the Syrian Arab Republic, Tunisia and the United Arab Emirates.

II.2. Local consultants

Algeria: Abdulla Hamdan

Egypt: Mohammad Amin and Yousif Mazhar

Jordan: Akram Karmool

Morroco: Ali Ghanam

Syrian Arab Republic: Abdalla Sallouta

Tunisia: Ali Saidan

II.3. Questionnaires were given to the following:

3.1 Bahrain

- Aluminium Bahrain Company (ALBA)
- Arabian Iron and Steel Company (AISCO)
- Arabian Strip Repair Company (ASRY)

3.2 Algeria

- National Steel and Copper Structures Company[1/]
- National Machine Tools Company (ENPMO)[1/]
- National Agricultural Equipment Company[1/]
- National Railway and Equipment Company[1/]

3.3 Egypt

- Engineering and Industrial Design Development Centre[1/]
- Iron and Steel Complex (Helwan)
- Copper Company (Alexandria)[1/]
- Metal Industries Company[1/]
- Nasr Forgings Company
- Stalco Steel Structures Company[1/]
- Metalco Metal Structures Company[1/]
- Industrial Construction and Service Company
- Misr Company for Engineering and Machine Tools

1/ Questionnaires were filled out and returned.

3.3 Egypt (Cont'd)

- Egyptian Company for Railroad Works[1/]
- Misr Company for Vehicle Bodies
- Nasr Car Company[1/]
- Transformers Company[1/]
- Boiler Company[1/]
- Helwan Machine Tools Company[1/]
- Nasr Foundry
- ICON Company
  Academy of Scientific Research and Technology.
- Metal Institute
- Cairo University
- Ain Shams University
- Helwan University
- Suez Canal University
- Major Consulting Company
- Major Contractors
- Major Scientific Research Centre

3.4 Iraq

- Scientific Research Centre
- Baghdad University[1/]
- Technology University[1/]

3.5 Jordan

- Dar Al-Handasah[1/]
- GCC.[1/]
- Yarmouk University[1/]
- University of Jordan
- The Royal Scientific Society[1/]
- Talal Abu Ghazaleh, Jordan
- ELBA
- Swalha Lift Company
- Solar Energy Panels
- Cables and Wires
- Construction equipment: Abbas Nabulsi Company
- Construction equipment: Nabil Saleh Zeki Company
- Factory producing vehicle parts
- Factory producing circuit breakers and distribution panels

3.6 Morocco

- CGE The General Electric Company[1/]
- Berliet-Maroc Moroccan Company for Automobiles[1/]
- SCIF-Societe Cherifienne de Materiel Industrial et Ferroviaire[1/]
- CMIM[1/]
- SIMEF[1/]
- Moroccan Engineering and Technical Projects Company[1/]

1/ Questionnaires were filled out and returned.

3.8 Saudi Arabia

- SABIC
- APICORP[1/]
- King Wilkinson[1/]
- Saudi Consult[1/]
- Foster Wheeler[1/]
- Kanoo[1/]
- Chiyoda Petrostar[1/]
- King Abdul Aziz University[1/]

3.7 Syrian Arab Republic

- University of Damascus[1/]
- Aleppo University (Aleppo)
- The Ba'ath University
- The General Company for Executing Industrial Projects[1/]
- Industrial Testing and Research Centre (ITRC)[1/]
- The General Establishment for Designs and Studies[1/]
- The Furat Tractor Company (Aleppo)[1/]

3.9 Tunisia

- Foundries and Mechanical Company (SOFOMECH)[1/]
- Industrial Hydromechanic Company (HYDROMECA) (SICAME)[1/]
- Societe Industrielle du Nord (SIN)[1/]
- Africa Industrie[1/]
- Gabus Complex for Metal Industries and Contracting (ACMG)[1/]
- Tunisian Electro Mechanical Engineering Company (SACEM)
- Industrial Company for Electric Equipment (SLAME)

1/ Questionnaires were filled out and returned.

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