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Study on An Integrated Development of Manufacturing Facilities for Automotives

A Framework for Regional Co-operation

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List of abbreviations

AIIC	Arab Industrial Investment Company
AIDO	Arab Industrial Development Organization
AFESD	Arab Fund for Economic and Social Development
C.V	Commercial vehicle
GVW	Gross vehicle weight
UNIDO	United Nations Industrial Development Organization

Preface

This study is part of the work programme of the ESCWA/UNIDO Industry Division relating to identification of regional projects in the field of capital goods and heavy engineering industries.

The programme aims at promoting the development of an integrated long-term regional pre-investment programme for the development of capital goods and heavy engineering industries with strong linkages related to national industrial facilities.

This is considered primarily as part of an overall strategy for industrial integration basically aiming at building up mutually interlinked industrial capacities for promoting inter-Arab trade in manufactured goods leading ultimately to economic integration.

An important objective of this programme is to attain a balance in the number and types of projects allowed to various countries for achieving an equitable distribution of benefits to be derived by participating member states.

The ESCWA countries(1) can be considered at initial stages of development activity concentrating on infrastructure in telecommunication, electricity generation transport and agricultural facilities etc. Additionally endigenous development of oil resources has been the priority and all these have led to a large scale of construction activity. Imports and consumption of capital goods has concentrated around these areas. Therefore first priority selection of ESCWA's work programme areas has been accorded to telecommunications equipment, electric power generation transmission and distribution equipment, transport and construction equipment and capital goods for chemical industries. A set of criteria has been used as a guideline for identifying the regional projects under consideration, these related to:

a. Size of the market; taking most countries separately, their local demand mould be insufficient in the foreseeable future to allow the establishment of economically viable manufacturing facilities.

b. Industries with strong forward and backward linkages and having the possibility of attaining a high local content through regional cooperation, rather than through establishing assembly plants within the bounderies of individual countries.

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(1) ESCWA countries include: Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, U.A.E. Yemen Arab Republic (YAR), People's Democratic Republic of Yemen and PLO.

c. Technology intensive industries with the priority to the development of industries with relatively stable technologies and technological skills which can provide a basis for the longer run objective.

d. Industries with high economies of scale or those industries abtaining economic viability through product mix.

e. Those industries that lend themselves to production split whereby production of certain inputs or components can be decentralized, thus effective economies of scale and affording even distribution of production capacities amongst ESCWA countries, besides achieving greater degree of vertical integration in industry.

f. Industries that have no critical locational factors and whose location is therefore determined with great flexibility.

Based on the above criteria, and after examination of present and projected investment programmes in ESCWA region and trends in imports, specific industries have been selected for preparation of techno-economic and feasibility studies. Among these industries are agricultural machines, commercial vehicles and construction equipment which are the subject of the present study.

The development of manufacturing facilities related to the agricultural machines (tractors), commercial vehicles and construction equipment is aimed to be studied in an integrated manner in order to derive the benefits of scale economies linked to the regional market, manufacturing technologies and above all to distribute the economic benefits among member states.

Introduction

Objective

This study incorporates an integrated approach for the development of industries which has close interlinkages. This integrated approach lends itself to regional cooperation because the industries identified within this approach will include projects that can be developed at the regional, sub-regional and national basis. Therefore the main objectives of the study is presented as:

1. Identification of packages of integrated regional sub-regional and national projects in the field of.

   (a) Manufacturing and assembly of agricultural equipment commercial vehicles and construction equipment.

   (b) Manufacturing of components related to agricultural equipment, commercial vehicles and construction equipment.

2. Set up an overall scheme and strategy for the development of this industry in the region.

3. Preparation of project profiles for the identified projects.

4. Preparation of pre feasibility studies for the identified projects.

It is to be stated here, that during the course of first part of this study, it was revealed that the demand for the major common component namely diesel engine is such a magnitude that it lends itself to establishment of more than one manufacturing facilities in the region without delay. As a result of coordination with other regional organizations, to avoid duplication, agreement was reached to join efforts in this respect. Accordingly AIDO, AIIC, Arab Fund and ESCWA joined hands to prepare, feasibility study for manufacturing diesel engines and its components. The study is progressing as scheduled and it is expected that the final report would be ready by second half of 1987.

Therefore the implementation of objective (4) above as related to the preparation of pre-feasibility/feasibility study would be the subject of separate studies.

Coverage

In order to obtain maximum commnalities and interlinkages, the following categories of equipment have been covered in the study:

(a) Agricultural tractors; conventional four wheeled (45-100) hp.

(b) Commercial vehicles: Trucks of 3.5 tons GVW and above.

(c) Buses: Capacity of (20-60) seats.

(d) Construction equipment: excavators, loaders dozers, cranes, and road construction equipment.

All above equipments are referred in this study as: "Automotive". Therefore the term means all the above equipment collectively.

Scope of the study

The major aspects of the study are:

1. Over view of world industry with due consideration to the organization of manufacturing facilities. Tendency of major producers as to expansion of activities within and outside ESCWA region.

2. Review of the manufacturing and assembly plants, manufacturing of components and the feeding industries, existing or planned in ESCWA region.

3. Examination of the present end use equipment population status and the projection of demand for each category of equipment in different countries of ESCWA region upto year 2000.

4. Analysis of common components among the equipment in view of technical and economic manufacturing threshold of each component and the extent of its applicability in the region.

5. Estimation of present demand and future requirements of certain components.

6. Formulation of a tentative scheme and strategy to be used as a guide for the development of an integrated industry.

7. Identify a package of national, sub-regional and regional industrial projects and prepare project profiles for the identified projects. Such profiles to include briefly:

(a) Description of product characteristics.
(b) Production processes with due consideration to viable capacity.

(c) Factory requirements: land, building, utilities and material.
(d) Production equipment

(e) Cost of buildings, materials and equipments.
(f) Manpower.

It is to be understood that the data included in these profiles are indicative and intended for identification and promotion purposes. It must be substantiated by detailed feasibility studies where many parameters will be completely specified as the case for diesel engine and components.

Source of Information

1. Information related to world production of different equipment were extracted from various publications of UNIDO.

2. Data on existing manufacturing, assembly and feeding industries were collected from limited published documents. Although questionnaires were sent to all member countries of the region, and inspite of follow up missions made, yet no answer was secured.

3. Data on present status of equipment population were acquired from various published documents including FAO production year books.

But due to major differences and severe discrepencies, in these publications the figures were adjusted based on the discussions in the field. Several methodologies were applied for demand projections. But also a great deal of "judgment" was applied by the staff of the Joint ESCWA/UNIDO Industry Division.

4. With regard to information on, lifetime of components, economy of scale of production, technology and process used, the information contained in the reports of specialized consultants were utilized.

Two specialized consultants were recruited for this purpose. The report of one reflecting, some how, the experience of developed and centrally planned economy. While the other reflecting the experience of an industrialized developing countries. The content of both reports provided important inputs for this study. Furthermore the life time of some components were also checked with some dealers in the region.

5. The construction cost, utilities and wages are the prevailing ones in the region and these are the same figures used in other studies.

Organization of the report

The study consists of two parts. Part I, incorporates five chapters. Each chapter covers as follow:

Chapter I: Presents an account of the production pattern of equipment among major producers in the world, and how the manufacturing facilities are related. The trend in technology and the tendency of the producers are also presented.

Chapter II: Describes the existing and projected assembly/ manufacturing facilities in the region including some feeding industries.

Chapter III: Covers the present status population of different categories of end use equipment. Also projection of such equipment up to the year 2000 for each country in the region.

Chapter IV: Discusses the two sectors of components and identifies common components and the classification with regard to design, marketing and technology. Selecting a certain number for further analysis of future demand.

Chapter V: Formulation of tentative scheme of strategies as a frame work for future co-operation in the region.

Part II of the report incorporates project profiles. Certain profiles are presented with some details while others due to lack of resources, only broad descriptions are given. Also some information on certain project ideas are presented as well.

Part I

Chapter I

Overview of the World Automotive Industry

The manufacture of agricultural tractors, commercial vehicles, buses and construction equipments are linked together. Many manufacturers produce all the products. Others produce agricultural tractors and commercial vehicles, or tractors and construction equipment.

The production of construction equipment accounts for no less than 20% of the total production of International Harvester, John Deere and Massey Fergusson, the leaders in manufacturing of agricultural tractors. On the other hand, the big auto-makers, such as Ford, General Motors, Volvo, Fiat allocates a portion of their resources for the manufacture of construction equipment as well.

All these firms, however are connected with large industrial holding companies whose economic interest lie mainly in the iron and steel industry and the heavy capital equipment sector. An example is Demag, one of the world's most important producer of heavy equipments for steel making, handling etc. Table (I-1) illustrates the distribution activities of few major companies in this field.

A brief account of the production pattern of these equipments among the major producers in the world is given below:

1. Agricultural Industry - Tractors:

The activity of the large world producers of tractors has stagnated or declined during the last decade. Sales on the markets of developed countries have fallen sharply. In the United States of America sales of tractors in number declined by 50 per cent between 1978 and 1982.

During the same period in France registration of tractors fell by 11.3 per cent. In Western Europe total tractor sales fell from 370,000 units in 1979 to 264,000 units in 1981, rising in 1982 to 268,000 units. World wide, in market economy countries, sales, declined by more than 26 per cent between 1976 and 1982.

Exports and manufacture under licence in developing countries have not furnished the relief, the large producers had hoped. The sales of tractors in the third world (excluding countries with centrally planned economies) have

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(1) Present situation of the agricultural machinery industry in North America and Western Europe, 21 December 1984, UNIDO IS.503.

fallen from more than 400,000 units in 1976 to less than 310,000 units in 1981.(1)

The slump has not only affected developed and developing countries with market economies. It has also hit countries with centrally planned economies. The markets of Eastern Europe now appear practically saturated. Unable to dispose of a significant portion of their production in the developing countries of their traditional zone of influence. The principal producers, Czechoslovakia, Poland, Romania and the USSR must seek export outlets, notably in Europe.

The geographic distribution of tractor production has not been fundamentally modified. It has remained heavily concentrated in industrialized countries. The slight advance of the developing countries was assured by China and India, while the share of Latin America and Turkey declined considerably-table (I-2).

Most of the large transnational corporations have had and are still having financial difficulties. These difficulties have been made worse by the fact that their other activities-notably the production of construction equipment and/or commercial vehicles have also been floundering.

In the industrialized countries existing equipment has been simply replaced without, an expansion of the market for conventional equipment. In many cases the sales of high-performance equipment adversely affect sales of lower-quality or less sophisticated equipment. It is this phenomenon that is confirmed by the stagnation of the number of machines in use and the increase in the average hp of tractors. In the Federal Republic of Germany, for example, the number of tractors in service in agriculture, forestry, and fishing remained relatively stable from 1971 (1.39 million units) to 1981 (1.47 million units) while the average hp doubled, reaching 40 hp. The average hp of tractors sold on the United States market went from 85 hp in 1972 to 98.6 hp in 1976, then to 102.4 in 1980. In France the average hp also rose from 60 hp in 1975 to 69 hp in 1979, and to 72 hp in 1982, and sales of four-wheel-drive tractors increased both in absolute and relative value.

In addition to strengthening technical and commercial organization, in order to defend their positions which is threatened by new producers, the large manufacturers are thoroughly reorganizing their industrial infrastructures. The concentration of machines, the closing of factories, and the consolidation of units throughout the world indicate that the large firms are falling back on their strongest bases. International Harvester is concentrating its units of production in the United States, France, and the Federal Republic of Germany and giving up its factories in Latin America, Asia, and Australia. Massey-Ferguson has also begun to reorganize its structure and is planning to shut down its Detroit unit (United States). The activity of this

unit would have to be transferred to Canada (four-wheel-drive tractors).

The organized companies at the world level are trying to control the world market by stepping up technical, economic and commercial agreements. Operations of this type have been increasing for the last 10 years, and may no doubt be explained by the fact that the big multinationals companies prefer to remain in a field where they have sound experience rather than embark on a diversification which they may consider risky in the context of the world economic crises.

This specialization goes along with the multiplications of technical, economic and commercial agreements which began some years ago and growing in the field of sharing of the range by large manufacturers under one commercial label, the intensification of supplying of components or parts among the large manufacturers. It is clear that the aim of all the efforts of the transnational corporations to reduce production costs or at least to slow their increase, and to improve the quality and reliability of equipment is to protect the privileged position of these corporations.

The tractor and other equipment have already completely mastered the common technological channels, and it is not in their best interest to encourage the emergence of alternative technology to their own equipment by helping to promote disruptive innovations. It is in their interest to proceed with progressive technological improvements in their products, adapting them to the economic, social and agronomical constraints which determine farmers demands for equipments.

2. Commercial Vehicles

The recent years have seen two major process of change in the auto-industriy including commrecial vehicle:

- A tendency towards an ever increasing internationalization of activities

- A tendency on the part of manufacturers to become assemblers rather than producers.

These changes have resulted from a necessity to produce more and more competitively in a more and more competitive market.

The major commercial vehicle (truck and bus) production takes place in the same geographical regions as that of passenger cars. In 1981 the majority of commercial vehicles were produced in Japan (more than 4 million units), followed by North America (2.1 million units) Western Europe (1.4 million units), East European countries including the USSR (1 million units) and developing countries with less than one million.

The major individual commercial vehicle manufacturers besides Japan are the United States (more than 1.6 million), Canada (nearly 0.5 million), France (more than 400,000), the Federal Republic of Germany (more than 300,000), the United Kingdom (229,000), Italy (176,000) and Spain (132,000). Among the East European, the main producers of commercial vehicles are the USSR (874,000 units), Poland (48,000) and Czechoslovakia (46,000). Tables (I-3) and (I-4).

As far as the share of world production is concerned, the major manufacturing centre is Japan (43 per cent) followed by North America (22 per cent), western Europe (15 per cent) and eastern Europe (11 per cent). Of the nearly 9.2 million commercial vehicles produced in 1981, 3.3 million units (38 per cent) were exported. The leading exporting countries were Japan (2.1 million units), Canada (330,000), the Federal Republic of Germany (204,000), the United States (170,000), France (157,000) and the United Kingdom (117,000). The main receivers of total world imports in 1981 were the United States (739,000 units), Canada (144,000), France (119,000) and Italy ((85,000).(1)

With regard to developing countries, the total production of commercial vehicles in 1981 amounted to 819,480 units (less than one million) which represents only about 8.5% of the total world production. The main producers of commercial vehicles are: Brazil with total production of 373,832 units (a decrease of 34% as compared to 1980), Mexico 241,621 units, India 106,781 units, Korea 64,324 units and Argentina, 32,922 units.

The uneven manufacturing activity in the commercial vehicle producing countries during 1977-1981 points to market instability and the ever increasing difficulties experienced by the industry. This is expected to continue 1980s.

A subject that may be raised in connection with future development of commercial vehicles relates to the concept advocated by certain multi-nationals on the so-called "world truck". This has been an elusive for vehicle manufacturers, mainly because variations in local market demands and regulations governing truck weight and design features prevent genuine uniformity. All the same, the potential benefits of economy of scale and savings in development costs make it an attractive concept. Adopting the idea, General Motors is the one company which has been moving ahead with a new strategy to manufacture and sell trucks on a world wide scale. Its recently formed worldwide Truck and Bus Group is emerging as the nucleus of a corporate plan to consolidate management of its currently scattered truck manufacturing,

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(1) Transnational corporations in the international auto-industry, U.N Centre on Transnational Corporations; N.Y 1982.

design and components operation, now run by several United States based division and overseas subsidiaries.

Centralizing GM's truck operations, which accounted for 18.7 per cent of its world-wide unit sales in 1981, is said to be a step towards enhancing the company's ability to design vehicles which can be manufactured, with only minor variations, anywhere in the world. GM's interest in reorganizing its truck activities stems partly from a growing body of opinion that the current slump in world-wide truck sales is accelerating the combining of heavy-duty manufacturers. The consolidation and strenthening of GM's world-wide truck operations is aimed at positioning the company to take advantage of future growth overseas. Its developing markets will be in, Africa, Asia-Pacific and Latin America and ESCWA region markets which had high growth rates in the 1970s and are projected to continue to be strong in the 1980s.

3. Construction Equipment:

The construction equipment is manufactured by a small group of advanced countries which have the necessary technological capability in the area of design and production, financial resources, commercial experience and management capacity. On the other hand, these are purchased by the majority of developing countries, particularly the countries in the ESCWA region.

More than 80% of the world wide sales in the construction equipment sector are made by the United States companies and their affiliated branches. In the construction equipment industry there is a clear correlation between export potential and money spend in research and development, and this is a critical factor in a company's efforts to maintain and expand its share of the market. The major US producers allocate about 3 per cent of sales revenues to research and development, a figure which is higher than the American industry wide average.

One of the world leading manufacturing in this field is the US Caterpillar Company, which together with its affiliates accounts for about 40% of world production. The Caterpillar Company specializes in the manufacture of heavy machinery, its sidelines being diesel engines and power generating units. A distinguishing feature of this company is its highly self-contained system of production which places minimal reliance on external suppliers; in fact, 82 per cent of the company's products are internally manufactured. The range of products exported is very varied. Much of the European market is served by the plants located in those countries, which also supply other markets as well.

Caterpillar sells about fifty per cent of what it produces outside the United States. The production centres located outside U.S teritory account for a high percentage of these sales. Plant sites are determined on the basis of

the geography of the markets and the need to satisfy higher volume demand competitively. This reveals the gradual internationalization of the actual production process.

The opportunities for complete specialization on a plant-by-plant or country-by-country basis are limited by the size of the production runs. External factors and economies of scale, in both production and transport, play a less important role than in the manufacture of mass produced capital equipment. The consequence is a higher degree of production integration by geographic regions specializing in specific types of machinery.

The Japanese construction equipment industry has been growing at the rapid rate of 20 per cent per annum. The limited size of the domestic market has been compensated through increased exports. Japan is a net exporter of construction equipment with its own market virtually closed to imports. Japanese companies which began to manufacture civil engineering machinery using technology developed by American and, in some cases, European producers - Komatsu (Bucyrus), Mitsubishi (Jumbo), Kobe (Harnischferger), Toyo (Clark Equipment) and Nihon (Orenstein-Koppel)-have pursued a policy of gradual autonomy which has enabled them to attain an export rate of 30 per cent.

Komatsu is the major Japanese concern in this sector. The second largest enterprise as regards the most important equipment is Caterpillar-Mitsubishi. Other leading firms are Hitachi, Nihon, Kobe and others. Japanese exporters have been particularly successful in the ESCWA region, one reason being that the unit value of Japanese exported equipment is low compared with the figures typical of US manufactured equipment.

The European industry occupies an important place in the manufacture of certain types of equipment: Power shovels, loaders, travelling cranes. US companies - caterpillar, Fiat-Allis, Bucyrus, Clark, etc. dominate the sector in the United Kingdom and are strengthening their position in France (take over of Poclain by case) and the Federal Republic of Germany (merger of Massey-Ferguson and Hanomog). Factors working to the comparative advantage of US producers are their technological know how, the complexity of the necessary warranty and sevicing systems, and the large financial resources at their disposal.

In Federal Republic of Germany the construction equipment industry is controlled by three major firms;

- Liebhen, 62 per cent of the company activity is in the construction equipment.

- Orenstein Koppel, where the manufacture of this equipment accounts for 52 per cent of the company's business.

- Demag, with only 14 per cent of its business in the construction equipment area.

In the United Kingdom the construction equipment sector is very largely dependent on external producers. Particularly noteworthy is the importance of component and spare parts manufacturing because of the role of US producers and the abundance of small and medium sized models.

The highest degree of specialization in France is found in the case of the poclain produced power shovels, which are exported to all countries of the world. This item represents about 45 per cent of all French exports in this industry.

With regard to developing countries only few are producers of heavy equipment. Included in the list; Argentina, Brazil, India, Korea and Mexico. Though Algeria is intending to develop an industrial complex to produce such equipment.

Such production is generally undertaken in close collaboration with the large international producers, either through wholly owned or partly owned subsidiries or through licensed technology. Because as mentioned earlier, the industry involves heavy research and development expenditures to maintain product competitiveness.

The above presentation reveals that the automotive manufacturing sector is an interlocking complex industry, which has gone through serious process of restructuring aiming at more internationalization, integration and specialization. Also the intensification of interchange of supply of components and parts among manufacturers.

As seen also, the industry is dominated by few multi nationals of the Developed Market Economy Countries. Yet inspite of this fact, several developing countries have made successful break throughs.

Chapter II

Status of Automotive Industry in the ESCWA Region

The automotive industry in the region is limited and has developed on the national basis, with no linkages between different manufacturing units. The manufacturing units for final product are mostly assembly units, with a low local content production. Details are outlined below:

1. Final Products

1.1 Tractors: Three assembly units with a total capacity of about 12,000 tractors per year per shift exist in the region. It has been reported that plans are underway to establish the fourth unit. These are:

1.1.1 Egypt: Tractors are assembled in El Nasr Automotive Manufacturing Company (NASCO), Helwan. In this company, CKD tractors imported from various origins are assembled. These are:

- Yugoslavian type IMR 60 CH, with an integration rate of 25 percent in value
- Romanian, Universal UT 65 CH, with an integration rate of 5 percent
- Massey-Ferguson 265 which replaces the MF165 originated in Great Britain

The production of tractors in this plant amounted to 3900 tractors in 1984 as compared to 3266 in 1983.

Future plans are anticipated: building a factory in Alexandria with Massey-Ferguson to assemble SKD tractors and then CKD tractors with an increasing rate of integration. The production to reach 5,000 units per annum.

1.1.2 Iraq: Tractors are assembled in the "General Company for Mechanical Industries", Iskandariyah. The first tractor was assembled in 1971 under the name of ANTAR, Czechoslovakian Zetor.

It is claimed that the local content has reached about 50 per cent of the cost of tractor. The components which are manufactured locally in the plant are:

- rear and front wheel ballast weight;
- fixed and swing draw bar;
- cooling system;
- pedals;
- front axle wheels;
- front mudguard and others.

Tractors of 70 and 80 hp are assembled but mainly is 70 hp model.

The production capacity is 5,000 tractors per year and it can reach 7,000 tractors per year with 300 working days.

1.1.3 Saudi Arabia: A project is envisaged by Massey-Ferguson and Juffali Brothers to assemble tractors. This project would be in Jeddah. Annual output planned to be about 1,500-2,000 tractors. Although the plant's size has not yet been confirmed, Massey-Ferguson plans to take 20 percent of the initial capital of the new company. The project would use components mainly manufactured by Massey-Ferguson in the United Kingdom.

1.1.4 Syria: Tractors are assembled in Al-Furat factory in Aleppo. This is a joint venture between Motor Iberica, S.A. of Spain (25 per cent) and the Syrian government (75 per cent). The assembly started in 1973 using imported 60 hp engine. Later other models were introduced, but since 1980 the production has been rationalized on one model namely 70 hp motor. It is reported that the local integration rate is about 80 per cent of the cost of tractor. All components and related ancillaries are made in the four shops of the factory which have recently been completed. These are:

- The foundry: casting of the tractors components with a production of 390,260 pieces/year or 6,000 tons.

- Forging: almost all main parts of tractors with a capacity of 1,200 tons/year, one shift.

- Stamping of the steel parts of the tractors with a capacity of 630 tons/year, one shift enough for 3,150 tractors. The stamping ensures about 5 per cent of the tractor components.

- Heat treatment: capable of handling components and parts related to 3,000 tractors per shift yearly.

With two shifts, the production capacity reaches 25 tractors per day, i.e. approximately 6,000 tractors per year.

1.2. Commercial Vehicles and Buses: Several assembly units are operating in the region. Some other units are underway. These are:-

1.2.1 Egypt: El Nasr Automotive Manufacturing Company (NASCO) has been producing trucks and buses since 1960 in co-operation with Magirus Deutz. The Egyptian Light Transport Manufacturing Company (ELTRAMCO) has been assembling vans and micro-buses. The production in 1981 and 1984 was reported as follows:

	1981	1984	
Trucks	2227	3350	nos
Buses	622	750	nos
Trailers	2240	n.a	nos

It was also reported that the production of pick-ups in 1979 amounted to 1027 but no production figures have been reported for years 1980 and 1981, presumably that this line of production is stopped.

There is considerable potential for expansion of the country's assembly operations. Some assembly projects for commercial vehicles are certain, with IVECO, the FIAT commercial vehicle subsidiary, being one of the most likely contenders. General Motors is building a truck plant at Alexandria, and together these ventures are expected to increase output to over 8,000.

The Arab American Motors (AAM), a joint venture between American Motors of North America and the Arab Organization for Industrialization, was established to assemble jeeps and other four wheel drive vehicles for the domestic market and for export- capacity 12,000 per annum.

It is not confirmed whether all these projects will be really implemented.

It has been also reported that the El Nasr truck assembly plant obtains 60 per cent of the ex-factory value of its trucks locally. This rises to 75 per cent in the case of buses.

1.2.2 Iraq: Iraq's domestic motor industry so far has been limited to a number of assembly operations where vehicles are made under licence from companies such as, Scania, Saviem (trucks) and Ikarus (buses).

The trucks are imported CKD, Saviem supplies the low and medium range vehicles (from 2-10 ton GVW), Scania supplies the high range vehicles (11.8-16.8 tons GVW). The mini buses, city and intercity buses as well as coaches are from Ikarus.

The production capacity and the total number produced in 1982 are reported as below:-

	Production 1982	Production capacity
Salah El Din (Saviem)	900	2,250
Scania	3,200	3,600
Buses	950	1,100

The local integration is about 10 per cent for trucks.

Iraq has plans to start assembly of cars and trucks on a substantial scale, although the original target date (1985) has been postponed due to the conflict with Iran. Investment is estimated to be of the order of $ 5 billion. To this end a consulting contract was awarded in May 1981 to West German consortium led by Weidleplan Consulting of Stuttgart. According to this company, the project involves integrated manufacturing and not assembly operations.

The scheme envisages production of a minimum of 120,000 cars a year and 25,000 trucks.

1.2.3 Kuwait: Although the country has no local vehicle manufacturing, but Kuwait has a considerable investment in foreign automotive companies. Kuwait bought 10 per cent of Volkswagen Brazil in June 1980, and is thought to have followed that purchase with the acquisition of around 6 per cent of VAG, West Germany. The country has several other holdings in German industrial companies, among the largest is a 14 per cent interest in Daimler Benz. Recently it has been reported that the country may be negotiating to purchase a further 10 per cent interest in Daimler Benz.

It has been reported that a project is underway to produce trucks in co-operation with Magirus Deutz. The production capacity is reported to be of 1,000 trucks per annum.

1.2.4 Saudi Arabia: The National Automobile Industry (NAI) in Jeddah assembles Mercedes trucks which are supplied CKD. The plant is layed out for 24 units per day or 6,500 per year to be produced in one shift.

It is currently assembling the following:-

Mercedes 1924 range, 19 tonnes GVW - 60 per cent of production
Mercedes 2624 range, 26 tonnes GVW - 30 per cent of production
Mercedes 911 range, 9 tonnes GVW
Mercedes 1113 range, 11 tonnes GVW

The total investment of NAI amounts to SR 90 million. This is a joint project between E.A. Juffali and Brothers

and Daimler-Benz. The company is 74 per cent owned by Juffali and 26 per cent by Daimler Benz.

NAI is in a position to produce 10,000 units per year with a second shift per day.

It is most likely that the major components (engines, gear boxes, etc.) would not be manufactured on site.

Japanese Hino trucks are also assembled in Saudi Arabia. The trucks are produced by Jamjoom Hiro Motors. As with the Daimler Benz project, the Saudi Arabian partner - in this case Jamjoom Brothers - has the 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 has been producing around 1,200 trucks a year.

1.2.5 Syria: The Syrian Government in 1981 investigated offers from Peugot, Renault, Volkswagen, BL and others to set up car assembly operations, but there has not been any progress so far.

Also it has been reported that a study for setting up an assembly plant producing 4,000 Magirus Deutz trucks per year is in planning stage.

1.3 Construction Equipment: Activities related to assembly of construction equipment in the region is very limited, almost not existing. Some minor operations are existing in some countries and in some others these operations are in the planning stages. These are:-

1.3.1 Egypt: It has been reported that 24 forklifts were assembled in 1978, but no production figures have been reported in 1980 and 1981, it may be assumed that the production line has stopped. Also more than 134 tonnes of cranes have been assembled.

1.3.2 Saudi Arabia: It has been reported that there is a project to produce hydraulic cranes under an American licensor.

2. Feeding and Related Industries:

2.1 Batteries: Four manufacturing units exist in the region. The total production capacity approaches 800,000 units as detailed below:-

The State Enterprise for Manufacturing Batteries in Iraq produces more than 24 types of batteries - chloride. The production capacity is reported to be about 480,000 units - more than 400,000 batteries were produced in 1982.

The United Industries Company in Jordan has produced 75,000 batteries in 1983. The production capacity is about 600 batteries/day.

The National Industries Company in Riyadh, Saudi Arabia produces also batteries for cars. But its operation seems to be on a smaller scale. It has been reported that the production capacity is only 45,000 batteries per annum.

No information is available about the Syrian Arab Batteries and Liquid Gases, Aleppo, Syria.

2.2 Radiators: More than ten plants exist in the region. The total production capacity is not known, but these are mostly small scale units to satisfy the local demand of replacement parts for cars. Although some units make radiators for trucks and tractors as well. These units are:-

- Baghdad Company for Manufacturing Radiators - Iraq
- Iraqi Radiators Manufacturing Company - Iraq
- Rafidain Company for Production of Radiators and Silencers - Iraq
- National Factory for Manufacturing Radiators - Iraq
- Light Industries Company - Jordan
- Kuwaiti Radiators Factory - Kuwait
- Shaihan Radiator Factory - Kuwait
- Al Salama Factory for Radiators - Saudi Arabia
- Al Fozan Factory for Radiators - Saudi Arabia
- Al Nahdah Factory for Radiators - Saudi Arabia

2.3 Diesel Engine: Egypt is the only country in the region where diesel engine is manufactured. But the engines are mostly for welding generators, standby generator sets, and to equip the irrigation pumps.

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

In Shubra Company, single cylinder, horizontal stroke, Deutz licensed of 6, 10, 16 hp engines are manufactured. All components are made in the same plant except injection pumps and sundry electrical equipment. The production capacity is 1,500 units per annum and plans are underway to expand to 2,500 units per year.

2.4 Tyres: Egypt, Iraq and Syria are presently manufacturing tyres. The production capacity and the type of tyres manufactured are not known. But it has been reported that the Syrian plant supplies the required tyres for tractors.

It has been reported that a joint tyre project, between Bahrain, Kuwait and Saudi Arabia is in the advanced planning stage. The capacity is expected to reach 4 million tyres per year.

2.5 Vehicle Bodies: There are significant capacities in each country to produce vehicle bodies, trailers and semi-trailers. In some of these plants, productions are carried out under licence, but in some others it is done under their own. Also capacities exist to produce bus bodies.

Chapter III

The Demand

1. Tractors

1.1 Present Status: The tractor population in the region for the year 1980 is indicated in table (III-I). This has been compiled from various sources and adjusted according to data obtained in the field.

The population refers to the agricultural sector. Other sectors such as construction, transportation and others, use considerable number of tractors for various activities which varies from 20 to 50 percent of the total population. The level differs from one country to another.

The population of tractors in Egypt, Iraq, Jordan, Saudi Arabia, and Syria represents substantial portion of the population in the region, and it is expected that it will continue for many years to come.

A brief description of equipment status in each country of the region follows below:

Bahrain: Reliable information on the population of agricultural equipment is not available, but it has been reported that the population of tractors in 1980 was about 80 mainly of small power ones.

Egypt: The use of agricultural equipment; tractors in Egypt is relatively small considering the cultivated area. There are conflicting figures as to the number of tractors in operation. Although the population of tractors in 1976 was put at 32,000, it was claimed that only 55 per cent of this number was in working order.

The sale of tractors remained consistent at a level of 2,500-3,500 numbers yearly between years 1973 to 1976. But this number has jumped to 5,000 in 1977 and to 7,500 in 1978 and then declinedto 1973/76 level.

Iraq: The total population of tractors in agricultural sector was reported to be 32,000 units in 1980. A large number was imported following this year namely 11,350 units in 1981 and 4,950 units in 1982. This is in addition to the local assembly which amounted to about 3,000 units yearly.

During the discussion in the field, the use of tractors in other sectors was put at 100 per cent of that of the agricultural sector. But this is somehow considered on the high side. In 1982, the tractors in non-agricultural sector represented no less than 60 per cent of that in agricultural sector. This, however, most likely will decline in the coming years when other means of transportation are readily available.

Jordan: According to the latest agricultural machine census conducted by the Ministry of Agriculture, the total number of tractors as of 1/3/1983 was put at 2,320 tractors in the agricultural sector. Various reports such as FAO Production Year Book reported that the total number exceeded 4,500 tractors in 1980.

The sale of tractors has been somehow consistent in the years 1973-1978 ranging from 200 to 350 tractors per year.

Kuwait: The total number of tractors in 1978 was estimated at 30 numbers. This may have been increased to about 50 tractors in 1980.

Lebanon: The population of tractors in 1977 was estimated at about 4,000 tractors mainly of small power. It is assumed that the population is the same in 1980, if not less, due to the events.

Oman and Qatar: The population in 1980 is estimated to be about 100 tractors in each country.

Saudi Arabia: The data on the population of tractors in Saudi Arabia are conflicting. The FAO Production Year Book reported the population in 1980 as only 1,200 tractors. This may be only in agricultural sector.

On the other hand, the sale of tractors for years 1975-1979 reported to be more than 7,000 tractors.

Some sources have reported that the total population in 1980 exceeds 9,000 tractors. Taking the yearly sale figures for the last 8-10 years, the population in 1980 most likely approaches 10,000 units.

Syria: The total number of tractors used in agriculture sector in 1980 approached 28,000 units. Some officials estimated the population in 1982 to be more than 34,000 units.

The use of tractors in non-agricultural sector is not very wide and it is anticipated not to exceed 20 per cent of that in the agricultural sector.

UAE: The use of tractors in UAE is limited and the population is estimated at about 60 tractors in 1980.

YAR: Information about tractor population is not consistent. It varies from 1,000-2,000 tractors in 1978. It is estimated that the total number in 1980 is about 2,000.

PDRY: The case is similar to YAR, the population of tractors in 1980 is put at 1,500 tractors.

1.2 Future Demand: Estimates of the future demand for agricultural equipment and tractors, is directly linked to expansion in cultivated land, changes in the agricultural system, and methods of cultivation and affected by the interaction of technical, economic and sociological factors. Therefore analysing the demand for agricultural equipment and tractors, over the past 10 or 15 years, in order to estimate the future demand, has several short comings namely:

a) The sales of tractors and other heavy equipment have often been determined over the past years, more by governmental policies and trade agreements passed between Arab States and industrialized countries for importation or local assembly than by the actual demand;

b) An analysis of the past ten years does not show reliable relationship between demand and certain acceptable variables as the demand was disrupted by major extra economic factors; political independance, and effects of land reform;

c) Further, the approach of correlating the demand and global economic parameters such as the GNP does not strictly lend itself to good estimates of future demand. Thus comparing GNP and the number of tractors/hectares for some countries, table III-2, indicates that the industrialized countries with intensive farming, mainly Western Europe and Japan, uses many tractors per cultivated unit area. On the other hand some other industrialized countries with extensive forming such USA and Canada, which have a high GNP, use less tractors per unit area. Therefore future demand through the year 2000 was estimated based on:

1- an estimate of the degree of mechanization in the agricultural system (expressed in number of cultivated hectares per tractor).

2- estimate of cultivated area.

The method involved the following:

- for each country, the cultivated area in year 2000 have been estimated. The estimates were based on several sources, taking into consideration the cultivable land in each country. These were checked during field missions. Whenever possible, the areas were divided into rain-fed farming and irrigated farming as detailed under:

Egypt: 4,000,000 ha, all irrigated

Iraq: 5,300,000 ha, only 2,000,000 ha irrigated and remaining rain-fed

Jordan: 600,000 ha, mostly rain-fed

Lebanon: 350,000 ha, rain-fed and 150,000 ha, irrigated

Saudi Arabia: 1,200,000 ha

Syria: 5,898,000 ha

- for each country the degree of mechanization in the year 2000 has been estimated as follows:(1)

Egypt: 1 tractor per 100 hectares

Iraq: 1 tractor per 88 hectares

Jordan: 1 tractor per 110 hectares

Lebanon: 1 tractor per 85 hectares

Saudi Arabia: 1 tractor per 65 hectares

Syria: 1 tractor per 85 hectares

- using above figures, the population of agricultural tractors has been estimated for each of the countries of the region through the end of the century.

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(1)This is as compared to:
1 tractor per 120 ha in Egypt in 1978;
1 tractor per 100 ha in Iraq in 1980;
1 tractor per 140 ha in Syria in 1982.

In accordance to informations received in the field.

The yearly demand has been calculated to cover:

- renewal of the existing population of tractors assuming a life cycle 8 years.

- allow to develop the population of tractors in order to meet the requirements at the end of the century.

- allow a certain percentage of the demand of tractors for use in non-agricultural sector.

Tables (III-3 to III-8) indicate the yearly demand of tractors according to this approach for some countries, where the use of tractors will be substantive. Other countries of the region, where agriculture and the use of tractors are limited, the demand was made on simple estimate method.

Accordingly the demand for tractors in the ESCWA region could reach (table III-9).

19,509 units in 1985

23,253 units in 1990

27,719 units in 1995

33,086 units in 2000

This means that the population of tractors in the region would increase from about 104,860 units in 1980 to about 212,592 units in 2000, i.e. an increase rate of about 4 per cent per year (table III-10).

Concerning classification of tractors according to its power, it is assumed that the present distribution will continue, which has been checked during countries field missions.

- 45 hp tractors about 20 per cent

- 70 hp tractors about 70 per cent

- 100 hp and above tractors about 10 per cent

Accordingly the demand classified by hp is estimated as follows:

	1985	1990	1995	2000
45 hp	3,902	4,650	5,544	6,618
70 hp	13,656	16,278	19,403	23,159
100 hp	1,951	2,325	2,772	3,309
	19,509	23,253	27,719	33,086

2. Commercial Vehicles and Buses:

2.1 Present Status: The population of trucks, vans and buses in use in the region from 1973 to 1980 is shown in tables (III-11 & III-12).

These have been compiled from various sources, and incorporate all different types of trucks, vans and buses.

Only trucks of more than 3.5 tonnes gross vehicle weight, are of interest to this study, because these are normally equipped with diesel engines of the same type as those used in medium power agricultural tractors.

No distinction is made in the statistics in the region between trucks of 3.5 tonnes GVW and above, from trucks of less than 3.5 tons GVW. In many countries, heavy and light vehicles are considered together.

In order to set up a basis for estimating trucks of over 3.5 tonnes GVW, and for similar size buses in the region, the pattern of commercial vehicles in use in some selected countries has been examined. Data relating to Iran, Spain and Turkey has been analysed. These data are summarized under:

a. Vehicles in Iran Feb. 1967

- Small buses (10-30 seats)	9,833	47 per cent
- Large buses (above 30 seats)	10,906	53 per cent
	20,739	100 per cent
- Pick-ups	4,500	9 per cent
- Light trucks (1-5 tonnes)	11,578	23 per cent
- Heavy trucks (more than 5 tonnes)	18,000	35 per cent
- Trailers	17,000	33 per cent
	51,078	100 per cent

b. Vehicles in Spain Dec. 1968

- Small buses (10-30 seats)	11,276	40 per cent
- Large buses (above 30 seats)	16,690	60 per cent
	27,966	100 per cent
- Pick-ups	289,561	46 per cent
- Light trucks (1-5 tonnes)	186,657	30 per cent
- Heavy trucks (more than 5 tonnes)	132,852	21 per cent
- Trailers	14,675	3 per cent
	623,745	100 per cent

c. Vehicles in Turkey, 1966

- Mini buses (less than 10 seats)	10,500	46 per cent
- Small buses (10-30 seats)	5,000	22 per cent
- Large buses (above 30 seats)	7,500	32 per cent
	23,000	100 per cent
- Pick-ups	16,000	20 per cent
- Light trucks (1-5 tonnes)	22,000	27 per cent
- Heavy trucks (more than 5 tonnes)	42,000	53 per cent
	80,000	100 per cent

From above, the pattern use of trucks differs from one country to another. For example in Iran the pick up ratio was 9 precent as compared to 20 per cent in Turkey. The ratio of light trucks (1-5 tons) in Iran was 30 per cent compared to 27 in Turkey and assuming that 60 per cent of this amount is for 3.5 tons, then the ratio of pick ups and trucks upto 3.5 tons becomes 23 per cent in Iran and 36 per cent in Turkey. In the ESCWA region as a whole, the share of pick-ups as well as vehicles of up to 3.5 tonnes GVW may well represent upto 30 per cent of the total population of commercial vehicles which represents about the average of the two countries; Iran and Turkey.

With regard to buses, since buses of (20-60) seats are covered in this study, therefore, the share of mini buses in the overall population represents a small portion. It is estimated that about 20 per cent of the total buses represents buses of 20 seats and below.

Based on this, the population of CV of 3.5 tonnes GVW and above, and of buses of (20-60) seats were established as a base to be used for projection of demand. This is summarized in table (III-13) which indicates that the population of CV in 1979 amounted close to one million units. But SEMA-Metra, in the study related to automotive, estimated the population in the whole Arab Region in 1978, as 300,000 units only. This estimate is very low and cannot be accepted, because according to this estimate, the density of trucks per 1000 inhabitants will be very low, as a matter of fact the lowest in the world.

2.2 Future Demand for C.V: In general the growth of demand of commercial vehicles is directly related to the development of transport of goods by road. On the other hand, the growth of transport by road is related to the development of agricultural and industrial products, and to the development of imports and exports of goods. This means that the growth of demand of CV is related to the economic growth. And since the economic growth is reflected by GNP, therefore, it is concluded that a correlation exists between the growth in the number of C.V. and the growth in the GNP for any particular country.

Table (III-14) shows the number of C.V. and buses per Thousand inhabitants and GNP per capita for some countries in the world, indicating strong relationship. Although some other factors may offset and modify this relationship, such as large transport requirement in mines, development of railway, changes in legislation on maximum axle loads etc,

In deriving the magnitude of C.V. population for the coming years in the region, the historical GNP per capita growth for some countries was anlysed. Due considerations were given to the economic development as well as to density of C.V.Accordingly a certain percentage of growth of C.V. population was set up for each country. These percentges were applied to the base 1979 population in order to obtain the population of C.V. in each year upto the end of year 2000.

Then the yearly demand has been calculated to cover:

- Renewal of the existing population of C.V. assuming the life time in the region 8 years.

- Allow to develop the population in order to meet the requirements for the period under study.

The analysis of growth rate of C.V. in each country of the region is followed hereunder:

Bahrain: The growth rate for trucks and vans for years 1976-1979 was about 4.37 per cent per annum. The number of trucks and buses per 1000 inhabitants (46) - table (III-16) which reflects that the market is stabilized as compared to some developed countries. Therefore the growth is not expected to grow high. Accordingly a rate of 3 per cent has been adopted for the projection of C.V. table (III-17).

Egypt: Although the average annual growth rate of GNP per capita for years 1970-1977 reached 5.2 per cent, but this was only 3.4 per cent for the period 1960-1980. Accordingly a growth rate of 3.5 per cent has been adopted for the projection of C.V. table (III-18)

Iraq: The annual growth of trucks and vans from 1974-1978 averaged 6.27 per cent. The average annual growth rate of GNP per capita for years 1960-1980 was 5.3 per cent.

In view of potentials to develop the C.V. market, the growth rate of 5 per cent has been adopted for the projection of C.V. table (III-19).

Jordan: The annual growth rate of trucks and vans in seventies has been very high. The growth rate of GNP per capita for years 1960-1980 was 5.7 per cent.

Therefore a rate of 5.5 per cent has been adopted for the projection of C.V. table (III-20).

Kuwait: The annual growth rate of trucks and vans for years 1976-1980 exceeded 14 per cent. But the growth in 1980 was only 8 per cent. This indicates that the boom which was witnessed in mid-seventies has been levelled. Number of trucks and buses per 1000 inhabitants was quite high 104 which reflects that the market is stabilized as compared to developed countries. Therefore a rate of 3 per cent has been adopted for the projection of C.V. table (III-21).

Lebanon: A growth rate of 3.5 per cent has been adopted for the projection of C.V. table (III-22)

Oman and Qatar: A growth rate of 3 per cent has been adopted for projection of C.V. in each country due to the fact that the market is quite stabilized as reflected from the high figure (46 and 118) respectively of the number of trucks and buses per 1000 inhabitants, tables(III-23 and III-24).

Saudi Arabia The annual growth rate of trucks and vans from 1975-1979 has been very large which exceeded 30 per cent. The market appears to be stabilized due to the fact that the number of trucks and buses per 1000 inhabitants (83) is high. Under such circumstances, a growth rate of 3 per cent has been adopted for projection of C.V. table (III-25).

Syria: The annual growth rate of trucks and vans from 1975-1978 was about 10.5 per cent. The average annual growth rate of GNP per capita for years 1960-1980 was about 3.7 per cent. Due to potentialities to develop the market of CV as indicated in the low (8) number of trucks and buses per 1,000 inhabitants, therefore a growth rate of 4 per cent has been adopted for projection of C.V. table (III-26).

UAE: The annual growth rate of trucks and vans for years 1975-1979 exceeded 40 per cent. The number of trucks and buses per 1,000 inhabitants was high (89) which reflects stable market, and accordingly a growth rate of 3 per cent was adopted for projection of C.V., table (III-27).

YAR and PDRY: The annual growth rate of trucks and vans in seventies exceeded 10 per cent. But due to some economic constraints, a growth rate of only 3.5 per cent was

adopted for the projection of C.V., tables (III-28 and III-29).

Based on the above, the population of C.V in ESCWA region for year 2000 amounts to 1,953,296 units as compared to 978,605 units in 1979 which represents an annual increase of about 3.5 per cent, table (III-30). Accordingly the derived yearly demand, table (III-31), in the region would reach:

166,291 units in 1985
196,094 units in 1990
231,468 units in 1995
273,693 units in 2000

This represents only (1.8 to 1.15) per cent of the world demand in 1985 and (1.9 to 0.9) per cent of the world demand in 1990 as compared to world projection indicated below:

Market Demand for C.V. (million)(1)

	Projection range 1985	1990
Total for N. America, W. Europe and Japan	3.4 - 6.35	4.6 - 6.4
Rest of the world	4.2 - 8	7 - 15
Total	8.8 - 14.4	10.4- 21.35

On the other hand, the projection made by SEM-Metra incorporated in a study on trucks, agricultural tractors, heavy construction machinery, was very conservative. The total demand of trucks for the whole Arab region amounted to:

81,000 units in 1985
109,000 units in 1990
145,000 units in 1995
192,000 units in 2000

which is almost 50 percent less than the above estimated demand for the ESCWA region only.

The demand arrived at for C.V. has been distributed according to different power engine, in the following manner, which has been arrived at as a result of discussions in the field missions.

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(1)Transnational corporations in the International Auto Industry, UN, Centre on Transnational Corp., proper furnishing needed. NY 1982

3.5-7 tonnes GVW are fitted with 70 hp engine
35 per cent

7-14 tonnes GVW are fitted with 140 hp engine
30 per cent

14-19 tonnes GVW are fitted with 200 hp engine
20 percent

over 19 tonnes GVW are fitted with 300 hp engine
15 percent

Table (III-32) shows the demand in the region according to power of engine.

2.3 Future Demand for Buses: Several factors affects the development of public road and transport system which is connected with the future demand of buses. These are:

- the demographic growth and the urbanization rate;
- the income growth;
- development of tourism;
- railroad distribution of traffic etc.
- development of public transportation systems.

In urbanized countries, with high income per capita the bus population and annual demand of buses will only grow moderately whereas the growth will be higher in countries of high percentage of rural populations with low income per capita.

For all the countries of the region, the growth rate of bus population has been taken as 3.5 per cent annually; being the same rate growth of C.V. Accordingly the population in year 2000 becomes 148,703 buses and the demands, based on life time of 8 years become as table (III-33).

12,434 units in 1985
14,769 units in 1990
17,541 units in 1995
20,832 units in 2000

3. Construction Equipment:

3.1 Present Status: The present status of construction equipment population in many ESCWA countries is rather uncertain, because among other things, there is a significant proportion of breakdown equipment that has long remained so due to the lack of available spare parts.

Regarding information about the present population and demand there is very little available. Therefore, the most promising way to obtain the needed information tends to be, to organize on the spot inventory. Even this may prove to be a tedious and costly operation. However, the alternative would be to rely on whatever patchy and incomplete data that may be available.

There are very few if any studies available concerning construction equipment in the region. From what is published some information could be gathered regarding the sale and working population figures. It is however to be pointed out that the sale figures do not necessarily represent the demand. Because, the sales may vary greatly from one year to another probably due to available funds and very likely as well, due to policy followed by the Government and public authorities regarding purchase, incentives, credit and import quotas. But in the absence of actual demand figures, the sale figures would be the only ones.

The preliminary study on the Viability of Manufacturing of Construction Equipment in the ESCWA region, December, 1980 prepared by Joint ESCWA/UNIDO Industry Division, points out that the only actual sale figures available in the ESCWA region are for years 1975 and 1976.

Accordingly sale figures and population of certain equipment for ESCWA region have been taken from the above mentioned study and summarized in tables (III-34 and III-35).

3.2 Future Demand: The number, size and power of construction equipment required is normally analyzed in terms of the type and the nature of construction work. The volume of material or supplies to be handled varies from one location to another and from one construction site to the other. These differences dictate the size and number of construction equipment to be used. Method of construction adopted in one location, or by one contractor firm, tends to be very often different from the method used by other contractors for a similar job, which influences the choice of construction equipment. These as well as other factors such as productivity, affect the demand for the equipment. In

the absence of a detailed analysis, the estimates are rough and are intended to give an order of magnitude.

As pointed out earlier the only available sales figures are for the years 1975 and 1976 which are incidentally considered as boom years in the ESCWA region and therefore should be taken as a base with reservation.

Accordingly within the limits of the presently available information, the forecast in the Joint ESCWA/UNIDO Industry Division study was made only for a period of 5-10 years. Therefore, the projections were restricted to 1980 and 1985.

The projection in the aforementioned study, is based on expenditure in construction since in general the bulk of construction equipment in any country is proportionately related to investment and pattern of construction. Investment in construction in turn is related to income and the level and modes of development in each country.

Taking the above into consideration, the following methodology has been adopted in estimating future demand:

1. Rough estimates for relationship between GNP and investment in construction and between investment in construction equipment and construction for the years 1975-1978 were established, using information contained in the five year development plans of some countries and relevant published data.

2. The estimated relationships established in (1) above, were used as a guideline, and together with the analysis of development trends. An estimate for similar relationships were made for the years 1980 and 1985.

An overall investment in construction equipment was estimated applying the projected GNP figures to the relationships so reached at.

3. The overall number of equipment needed were estimated using an average value of a unit equipment (1975).

4. In order to breakdown the overall number of equipment to different types, an index number, representing the relation between different types of equipment was set up. This index was arrived at by analysis of several construction bids and interviewing some contractors.

5. Applying the above index number, the demand for different types of construction equipment in each country was obtained.

6. The demand figures arrived at by 1980 represent about 3.2 per cent of annual increase over 1975 sales figure, and the demand figures by 1985 represent about 5.5 per cent of annual increase as compared to 1975 sales

figure. The latter percentage appears high, in particular, the construction activities have slowed down lately. It would be more reasonable to adopt the former growth rate 3.2 per cent per annum to project the equipment demand for years 1980-2000.

Tables (III-36) to (III-43) shows the demand figures for different categries of equipment. Table (III-44) gives the total demand for construction equipment in the region.

From afore-mentioned projections, it is concluded that the gab between the demand and supply (existing assembly/manufacturing units) of end use equipment in the region is such a magnititude which lends itself to establishment of several assembly/manufacturing units. Some of these may be extensions to the existing ones and others as a new establishment.

Chapter IV

Common Components

In the preceding chapter, the demand of end use equipment, namely; tractors, commercial vehicles, buses and construction equipment were quantified. This will give rise to the demand of components. All these equipments have common components like clutches, brakes, steerings, rubber parts, etc. Although designs and specifications of the particular components required for various applications may differ, their manufacturing technologies and therefore the manufacturing facilities are similer. The manufacturing unit of a certain component required to cater to the needs of one category of equipment can easily produce components for the other categories and thus improve the economy of scale.

Manufacturing of components which would seem unvaible if exclusively undertaken for one category of equipment would become viable if the three industries were developed together. Accordingly this call for the demand study of components in the integrated manner.

This chapter deals with the common components and how it is classified and hence certain common components have been identified as investment apportunities and quantum of demand has been defined.

1. Identification of common components:

An indicative list of common components used equally in agricultural tractors, commercial vehicles and construction equipment is detailed in Table IV-1. The parts listed are grouped by function which is widely accepted by the industry and market.

The common components may be also grouped by the followings:

1- Kind of market
2- Complexity of technology
3- Complexity of design

With regard to components, which relates to the kind of market which absorbes them, there are two major market areas where components and parts are used:

1- Original equipment manufacturers/OEM and
2- Aftermarket replacement area in otherwords, spare demand

From a manufacturing point of view, the OEM parts usually need heavy investment, sophisticated machinery, skilled manpower, high quality bought-in-material etc., because of the complexity of the design of components. Aftermarket

replacement parts and components are the one which has shorter life expectancy, are simpler by design, the manufactring technology is simpler than that of the OE parts, hence this segment needs conventional machinery which is cheaper than that of the OE components need.

OE components are manufactured by /1/ large OE manufacturers or /2/ by medium and large specialized /integrated/ companies, while aftermarket parts are manufactured by medium and small size manufacturers.

Examples as to original equipment components are:

- Gear box
- PTO shaft + propeller shaft
- Clutch
- Axles/front, rear, tandem trailer/
- Brakes
- Shock absorbers
- Steering
- Wheel rims
- Superstructures, bodies, cabs, chassis
- Seats
- Springs
- Instrument panel

While typical aftermarket components are:

- Linings /brake, clutch/
- Fuses, switches, fuse boxes
- Horns, wipers
- Light fittings
- Gaskets
- Rubber mouldings and hoses
- Windshield and glass
- Shock absorbers
- Chains, sprockets
- Track shoes, sprockets
- Hydraulic jacks
- Oil seal
- Bearings

With regard to common components which relates to complexity of technology in manufacturing, this is characterized by manufacturing machinery and quality control. The complexity degrees which are applied are high, medium and low.

1. For manufacturing high complexity technology, this requires:

- Special custom-designed machinery or installations /not listed in catalogues/ for one or more special operations, such as stationary transfer machines and the like.

- Automatic cycles with flexible programming of every type: numerical control, computerized numerical control amd the like; machining centers.

And for quality control, requires:

- Use of test stands for non-series-produced and/or heavy products.

- Highly specialized testing /usually performed to order/ of complex equipment.

Typical components which require high complexity technology are:

- Fuel injection equipment
- Gears, gear boxes
- Axles
- Clutch
- Brakes
- Steering
- Hydraulics
- Bearing

2. For manufacturing medium complexity technology, this requires:

- Machinery, equipment or installations with semi-automatic performance cycles

- Catalogue-listed machinery, equipment or installations with automatic performance cycles and fixed, rigid working programmes

And for quality control, requires:

- Dynamic operational testing, with or without standard, not involving the use of a special test stand

- Use of special test stands for series-produced products

Typical components which require medium complexity technology are:

- PTO shaft + propeller shaft
- Linings
- Alternators, starters, motors
- Fuses, switches, fuse boxes
- Horns, wipers
- Assembly of CVs
- Assembly of Ag. tractors
- Assembly of construction equipment
- Construction equipment accessories

3. For manufacturing low complexity technology, this requires:

- Machinery, equipment or installations with universal operating cycles and fully manual or almost fully manual operation; common, conventional technology of limited precision

- Machinery, equipment or installations of advanced universal design and /or high precision

And for quality control, requires:

- Pressure, static load, dynamic equilibrium welding, etc.
- Geometric testing according to standards

Typical components which require low complexity technology are:

- Seats
- Chains, sprockets
- Track shoe sprockets
- Leaf springs
- Coil springs
- Oil seal
- Gaskets
- Rubber mouldings and hoses
- Light fittings

With regard to common components which relates to complexity of design the degrees which are applied are; high, medium and low. The main features are:

1. For high complexity of design

Large size and great power performance, standards, and advanced metrology. Testing and inspection. Greater guarantees. Typical components which require high complexity of design are:

- Gear box
- Brake

- Axle
- Steering
- Clutch
- Hydroulics

2. For medium complexity for design

Medium in size, power, variety, performance and quality. Medium level metrology. Testing, medium gurantees. Typical components which require medium complexity of design are:

- PTO shaft + propeller shaft
- Shock absorber
- Horns, wipers
- Fuses, switches, fuse-boxes
- Instrument panel
- Linings /brake, clutch/
- Bearings
- Track shoes, sprockets
- Rubber mouldings and hoses
- Chains, sprockets

3. For low complexity of design

Simple in size, power, variety, performance and quality. Simple inspection. Average guarantee. Typical components which require low complexity of design are:

- Wheel rims
- Springs /coil and leaf/
- Seats
- Gaskets
- Light.fittings
- Superstructures, bodies, cabs, chassis
- Oil seal
- Windshield and glass

In view of the analysis presented above, and with due consideration to the present status of the automotive industry in the region, the following common components have been identified for further detailed examination and analysis in an integrated manner, these are:

- Engine valves: Due to kind of market, spare demand.
- Clutch plates and brake lining: Due to kind of market, spare demand and because of medium complexity technology
- Automotive gears: Due to kind market, and spare demand.
- PTO shaft anf propeller shaft: Due to kind of market.
- Shock absorbers: Due to kind of market, as spare demand.
- Fuel injection: Due to kind of market, as spare demand.

- Panel instrument: Due to kind of market.

- Alternators starters: Due to kind of market as spare demand and because of medium complexity technology.

- Windshield glass: Due to kind of market, spare demand and because of low complexity technology and design.

- Gaskets: Due to kind of market, spare demand, and because of low complexity technology.

- Oil seals: Due to kind of market, spare demand, and because of low complexity technology.

- Rubber components: Due to kind of market, spare demand because of low complexity technology.

- Wiper motor: Due to kind of market, and because of medium complexity technology.

- Water pump assembly: Due to kind of market, and because of medium complexity technology.

- Bimetal bearings: Due to kind of market, and because of medium complexity technology.

- Under carriage components: Due to kind of market and because of medium complexity technology.

- Cutting edges: Due to kind of market, and because of medium complexity technology.

- Plastic components: Due to kind of market and because of low complexity of technology.

- Leaf springs, coil springs: Due to kind of market and because of low complexity technology and design.

- Filter elements: Due to kind of market, and because of low complexity technology and design.

- Mechanical cables: Due to kind of market and because of low complexity technology and design.

- Fuses, switches: Due to kind of market and because of medium complexity technology.

2. Estimation of Demand Common Components

In forecasting the demand for components, two sector requirements should be considered, these are:

(1) The original equipment manufacture, OEM sector
(2) The aftermarket, in otherwords, spare demand.

The OEM demand is estimated on the bases of requirements of each of the categories of equipment and it is related directly to the number and type of agricultural equipment, commercial vehicles and construction equipment.

Forecasting the demand for the aftermarket component is a more complex task and is based on an item by item estimation. The estimation must consider the local experience with respect to road conditions, climatic conditions, spare part supply and maintenance, availability of skilled manpower and driving methods.

Furthermore, in forecasting the annual demand of the spare demands, some assumptions should be made in respect of:

- Life expectancy of the equipment
- Life expectancy of component
- Average annual working hour of equipment

From above, it is clear that without a detailed field survey, it would be difficult to pin point the quantun of demand. There exist some surveys and data based on the experience of developed countries. Such data are presented as examples in tables (IV-2 and IV-3).

Additionally, analysis related to life expectancy, change cycle of certain components, based on the experience of some developing countries adjusted to prevailing conditions in the region is made. Due to limited available resources, such exercise has been performed only for few components as detailed below, the methodology may be used as guide for computing the demand of other components.

1. Fuel injection equipment

Basically the fuel injection equipment consists of the pump and replaceable components, namely, nozzles, elements, delivery valves etc. Pumps as such are not replaced very often and definitely not during the initial 5 to 7 years of the life of the vehicles. On the other hand, components like nozzles, elements and delivery valves, require periodical replacement. The number of nozzles, elements and delivery valves is directly linked to the number of cylinders in the engine. The replacement cycles for these components would be once in 12 months or alternatively once during 100,000 kms run. This norm is observed in many developing countries. The replacement requirement for the above components during the years 1990 and 2000 in ESCWA region have been worked out on the basis of cylinder as follows:

Category of vehicles	No. of cylinders	Population 1990	Population 2000	Replacemnt cycle	Requirement 1990	Requirement 2000
Tractors	3	150,000	213,000	1	450,000	639,000
Light commercial vehicles	4	1,000,000	1,500,000	1	4,000,000	6,000,000
Heavy commercial vehicles (25-35% of total)	6	400,000	500,000	1	2,400,000	3,000,000
Buses	6	100,000	148,000	1	600,000	888,000
Total					7,450,000	10,527,000

The requirements of the above components to earth moving equipment has not been included because first, earth moving equipment itself is subject to arduous working conditions and the application they are put to are severe. The equipment being expensive, one can not afford to have any failures in the function of this equipment for any length of time.

Secondly, the total volume of the earth moving equipment in operation being small, the spares requirements are low not justifying economic manufacture. As a corollary to the above leading manufacturers of heavyduty engines for earth moving equipment have evolved over a period of time their own fuel injection system and they themselves undertake the manufacture of fuel injection equipment including spares.

2. Engine valves

Based on the experience of certain developing countries the norms used for estimating replacement demand for engine valve is worked out as follows:

Description of vehicle	No. of cylinders	No. of valves	Change cycle	Replacement requirement/yr
Light C.V.	4	8	2	4
Heavy C.V (25-35% of total)	6	12	2	6
Buses	6	12	2	6
Tractors	3	6	2	3

Based on the above factors the demand projection for valves during the years 1990 and 2000 in the ESCWA region works out as under:

Category of vehicles	Population 1990	Population 2000	Demand 1990	Demand 2000
Light C.V.	1,000,000	1,500,000	4,000,000	6,000,000
Heavy C.V.	400,000	500,000	2,000,000	4,000,000
Buses	100,000	148,000	600,000	888,000
Tractors	150,000	213,000	450,000	639,000
Total			7,050,000	11,527,000

3. Automotive Gears

Automotive gears consists broadly of two groups, namely, transmission gears used in the gear box and the differential gears used in axles. The number of gears in a gear box varies from 10 to 20 depending upon the category of the vehicle. In so far as the differential gear is concerned, it consists of a crown wheel and a pinion and 4 to 6 differential gears. The major replacement requirement for either transmission gears or differential gears come from heavy duty vehicles particularly trucks/which carry heavy loads. To a limited extent gears used on light commercial vehicles and tractors also call for replacement, although after long intervals.

The gears of construction equipment come under a different category all together, and hence requirements of equipment and the process involved are different. And since the total population is small, therefore the production of

replacement requirement may not be economical. An average replacement cycle of 5 years has been assumed for commercial vehicles of all types including light commercial vehicles and agricultural tractors. The norms adopted for this are:

Category of vehicle	Replacement cycle (years)	Replacement rate per annum (Kg per equipment)
Commercial vehicles		
Light commercial vehicles	5	6
Heavy " "	5	15
Buses	5	15
Tractors	5	3

Based on the above norms the replacement requirement of gears for the years 1990 and 2000 in the ESCWA region is estimated as under:

Category of vehicles	Replacement norm per Kg per vehicle	Population (in million) 1990	2000	Demand (tons) 1990	2000
LCVs	6	1.0	1.5	6000	9000
Buses	15	0.1	0.148	1500	2200
Trucks	15	0.4	0.5	6000	7500
Tractors	3	0.15	0.213	450	639
Total				13950	19339

4. Shock Absorbers

The wear and tear of the shock absorbers depend upon the category of the vehicles, the mileage done and the road conditions. The replacement cycle varies from vehicle to vehicle, for that matter it varies from place to place. Taking into consideration the experience of certain developing countries, the following replacement frequency norms have been assumed:

- Commercial vehicles of all types — once in 2 years
- Buses — once in 2 years

Accordingly the demand for shock absorbers is estimated as under:

Class of vehicles	Replacement norms	Population 1990	Population 2000	Demand 1990	Demand 2000
LCVs	2	1,000,000	1,500,000	2,000,000	3,000,000
Medium/heavy duty commercial vehicles	2	400,000	500,000	800,000	1,000,000
Buses	2	100,000	148,000	200,000	296,000
Total				3,000,000	4,296,000

5. Clutch plates and brake lining

Based on the experience of some developing countries the following replacement frequencies have been adopted:

Category of vehicle	Change cycle in No. of years
LCVs	3
HCVs	2
Buses	2
Tractors	3

Accordingly, the demand for the replacement clutch plates works out as under:

Class of vehicle	Population (in million) 1990	2000	Demand (in million) 1990	2000
Light commercial vehicles	1	1.50	0.30	0.50
Heavy commercial vehicles	0.40	0.50	0.20	0.25
Buses	0.10	0.15	0.05	0.08
Tractors	0.15	0.21	0.50	0.70
Total			1.05	1.53

The corresponding requirement for clutch facing would be as under:

Class of vehicle	Replacement in Kg per vehicle	Replacement in (tons) 1990	2000
Light commercial vehicles	0.60	200	300
Heavy commercial vehicles	0.80	160	200
Buses	0.80	40	60
Tractors	0.26	14	19
Total		414	579

As the technology and the raw materials required for the manufacture of clutch facing and brake lining are similar, and assuming the replacement cycle for the brake lining similar to that of clutch facing, then the demands for brake lining would be as per details given below:

Class of vehicle	Replacement in Kg per vehicle	Replacement in (tons) 1990	2000
Light commercial vehicles	3.73	1240	1860
Heavy commercial vehicles	5.60	1120	1400
Buses	5.60	228	342
Tractors	0.30	15	21
Total		2603	3623
Grand total		3017	4202

6. Rubber components

Rubber components covers a wide range of items. For example, rubber mats, radiator hoses are considered simple items. On the other hand, brake hoses, V.belts are considered sophisticated items.

The replacement requirement for hoses is assumed on the basis of 2 hoses for each vehicle and a replacement cycle of once in two years. The replacement demand for 'V' belts is also of the same order but in this case only one piece per vehicle is taken into account. In the case of brake hoses the replacement cycle for a pair once in 3 years. Thus the demand for various categories of rubber components works out as follows:

Description	Demand 1990	2000
Hoses (million Nos)	1.5	2.2
V.belts for fan "	0.75	1.1
Brake hoses "	0.5	0.7

7. Gaskets

Gaskets are fast moving components for the replacement market. The frequency of change of gaskets varies from vehicle to vehicle and their operating conditions. The demand is in direct proportion to the population of various vehicles and the replacement requencies. Based on the experience of same developing countries, the following replacement norms have been adopted:

Class of vehicle	No. of gaskets/ vehicle (Nos.)	Replacement frequency years	Replacement requirement per year (Nos)
Light commercial vehicles	50	2	25.0
Heavey commercial vehicles	70	2	35.0
Buses	70	2	35.0
Tractors	70	2	35.0

Based on the population estimates and applying the above norms the demand for gaskets is estimated as follows:

Category of vehicle	Replacement norms (Nos)	Population (million Nos) 1990	2000	Demand (million Nos) 1990	2000
Light commercial vehicles	25	1.00	1.50	25.0	37.5
Heavy commercial vehicles	35	0.4	0.5	14.0	17.5
Buses	35	0.1	0.15	3.5	5.25
Tractors	35	0.15	0.21	5.3	7.40
Total				47.8	67.65

8. Cutting edges

Cutting edges and blades are used in bulldozers and scrapers and these require periodic replacement. It is estimated that the cutting edges/blades if manufactured to correct specifications have 500 hours operating life. There are 3 blades on a scrapers and 2 blades in dozers, each of approximately 12 inch in length. These blades have cutting edges on both sides and could be used twoice by reversing the blades. Taking into account the total population of 20,000 construction equipment consisting of scrapers and buldozers there is significant demand for these cutting blades. Even on a conservative estimate the demand works out to 150,000 per annum based on a 500 hours operating life.

9. Bimetal bearing

The bimetal bearing are replacement items, normally required when overhauling the engine. The number of bearings differs from engine to engine depending on the number of cylinders. For example six cylinder diesel operated heavy vehicles have 13 bearing and 3 cylinders have seven bearings. The replacement cycle is around two years for commercial vehicles and tractors. Based on the population of these equipments, the annual demand would be about 7 million sets.

10. Oil seals

Based on the experience of developing countries, the replacement norms for various class of vehicles has been arrived as given below:

class of vehicles	Replacement nos. per year	Population 1990	Population 2000	Demand million 1990	Demand million 2000
LCV	4	1.0	1.5	4	6
HCv vehicles	6	0.4	0.5	2.4	3.0
Buses	6	0.1	0.15	0.6	0.9
Total				7.0	9.9

Chapter V

A Framework for Regional Co-operation

1. From the analysis presented in chapter I, it is clear that the automotive manufacturing sector of the industrialized nations forms a complete interlocking complex. The whole of the industry is inter-dependent and no single unit comes near to being self-supporting or independent. Amongst the giant and large companies, there is a great complex of supporting organizations, without which the system could not exist. The major companies need to interact with each other as well as with the smaller subsidiary or independent companies.

There are several companies which exist supplying products to the market who buy their components from a competitor who is also serving that same market. Examples are auto suppliers that purchase their engines and transmissions from Ford or General Motors. In the earth moving field caterpillar is established as the number one company but there are competitors that are in the same business buying their engines and transmissions from Caterpillar. Clark construction similarly supplies transmissions and final drive units to their competitors.

The giant auto-companies, which rank amongst the largest in the world, buy their brakes and electrics from specialist producers; and so the list goes on showing that industry is a huge interdependent complex. The interdependence does not stop at national boundries either, it now exists world wide.

It can be seen therefore that automotive manufacturing is highly structured "horizontally". Different units exist side by side and are in constant interplay with each other. These links are horizontal usually among separate enterprises.

In the ESCWA region, the structure of the automotive manufacturing sector presented in Chapter II, consists of a very limited scattered enterprises with minimum links between each other. They may be described as "vertically" structured, where each enterprise is independent and separate with little or no interplay. The only links are vertical within the same organization.

In order to develop this sector in the most appropriate manner in the region, it has to be structured horizontally rather than verticaly. This is the basic strategy that has to be adopted.

2. In terms of quantum of demand of end use equipment, the projections as indicated below shows that there is scope

for establishment of several assembly/manufacturing units in the region.

Annual demand (Nos.) ESCWA region

Equipment	1985	1990	1995	2000
Tractors	16,361	19,525	23,298	27,826
C.V.	166,291	196,094	231,468	273,693
Buses	12,434	14,769	17,541	20,832
Construction equipment mainly:				
Loader	4,713	5,516	6,454	7,550
Dozer	3,932	4,597	5,380	6,294

From the data available and that collected in the field, the number of end use equipment produced in 1981/1982 are:

- Tractors (Egypt, Iraq, and Syria) Total 12,000 units
- C.V. & Buses (Egypt, Iraq, Kuwait, and Saudi Arabia) Total 15,000 units
- Construction equipment (Loaders & Dozers) Nil

Assuming that the production capacities have remained stable during 1982-1985, then the region is:

- 73% self-sufficient in tractor production
- 8% self-sufficient in commercial vehicles and buses
- 0% No production capacities with regard to loaders and dozers

The tractor production covers fairly good percentage of demand. Therefore any additional facility should be planned cauiously. Extension to existing plants to be determined upon the requirements of higher sizes of tractors.

With regard to C.V., accepting the claim of many developed market economy companies, that the scale economy for C.V. lies between 10,000 and 20,000 units, but over 20,000 would be a more realistic minimum.

This by itself lends to establishment of several units in the region. But instead, it is recommended that the existing facilities in Egypt, Iraq, Kuwait and Saudi Arabia to be extended to the range 10,000-20,000 units each.

The assembly/manufacturing of loaders and dozers are made on a very small scale in the neighbourhood of 500

units. Accordingly, the demand calls for the establishment of at least two units in the region.

3. The demand as seen, whether using 3% a year or 5% increase will not make a great deal of difference, because it is considered as already exceeding the threshold.

But the existing population of end use equipment, tractors, C.V. buses and construction equipment consists of a large variety of makes, types, and sizes. The demand will most likely follow the same pattern. Therefore, this poses a real problem for the development of integrated manufacturing facilities in the region.

One of the options to overcome this problem is to advocate the concept of developing these equipment in such a manner to fit all the market requirement with minimum variations. An "Arab Truck" similar to an advocated "World Truck".

4. The best strategy to be adopted for the development of this industry in the region is the "parallel path". This in addition to development of facilities related to assembly/manufacture of end use equipment also to promote the establishment of projects related to component sector in order to feed the existing and future plants related to end use equipment in integrated manner.

A "package" of such integrated projects has been identified. A tentative scheme for the development of these projects is outlined in Annex I. Project profiles are presented under part II of this study as investment opportunities.

For the purpose of this study, the region has been divided into two sub-regions. The non-Gulf sub-region incorporating Egypt, Jordan, Lebanon, Syria and the two Yemens.

The Gulf sub-region incorporating, Bahrain, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and U.A.E.

5. In planning to set up an integrated industry, one can distinguish two types of component manufacturing.

- The first produces components for the original equipment manufacturing (OEM) and

- The second which produces parts and accessories designated for automotive replacement after sales - or spares demand. The main features of the two types of components may be summarized as follows:

- OEM products require heavy investments in plant and development costs and need large production volume to allow for adequately economic returns. After market products (the spare parts) need lesser investment and make quicker return.

- Aftermarket replacement spare demand sector is much more flexible than the OEM sector and produces items which have low per-unit prices.

- To be competitive on the market, most of the companies supplying the O.E. market have to make heavy investments in research and specialized production equipment.

- Since the production of O.E. components such as frames, axels, transmissions, etc. require large start-up costs, O.E. companies require very large guaranteed total-unit runs in order to produce an adequate return on investment.

- Contrary to the O.E. component manufacturers, the replacement aftermarket component producers do not require the magnitude of plant and development costs that O.E. suppliers do.

In view of the above the strategy would be to take a thrust into the aftermarket component direction and only as a second step move towards the O.E. manufacturing.

Based on this, most of the project profiles presented are for aftermarket components. Only a few are considered for O.E., and are presented to illustrate the extent and scope of such manufacturing units.

6. The variety of end use equipment as mentioned earlier is relatively large. Consequently, specifications of the components that go into the equipment either as O.E. fittings or as spares would be wide and varied, thus preventing standardisation of components in terms of types and sizes. Diversity of sizes and types prevents in many cases mass production techniques being employed for components production. For most of the items identified for production in the ESCWA region, the projected demand is significantly large. The large demand would normally suggest establishment of plants with completely automated production techniques. Automation would no doubt have the advantage of ensuring consistency in the quality of the product on the one hand and reducing the cost of production on the other, should the volume of production be large enough to lend itself to the automated line of production. However, since the demand is spread over a large variety of equipment with sources ranging from Japan to Europe and the United States, the spares requirements would also vary correspondingly in terms of size, specifications and types. Having regard to these factors it is recommended that the plant and equipment installed should be such that they are suitable for frequent changes of tooling. It is also of utmost importance that the manufacturing units should have sufficient flexibility to take up production of components conforming to different specifications. It would be possible to have units with relatively smaller capacities to start with, without

adversely affecting substantially the economics of production.

7. Several developing countries have launched a similar approach, such as Korea. But it is interesting to note that, some of the problems which were experienced by the enterprises, at the early stages of new set-ups, are somehow applicable to ESCWA region. Among these problems are: supply, market, manpower, etc.

8. It is inevitable that during the initial stages of development, a certain amount of protection will be given to manufactured products.

It would be too much to expect the new entrants to produce sophisticated components and market them effectively.

Any new organization needs time to develop its processes and methods, to train its labour and to increase its efficiency and so reduce its costs. Since existing company is striving always to improve its performance, then it is obvious that a new entrant cannot at first compete on equal terms with one which has been already in the market for several years.

9. A liberal approach is to be followed with regard to allowing foreign investment and collaboration for the development of this sector. It is just not possible to establish an industry without enlisting the assistance of experienced technologists in the products and the manufacturing techniques involved.

It is better, quicker and eventually cheaper to obtain the essential technology from a proven operator in the field. Such technology has to be modern and advanced, which has already been tried and proved in the region.

Later when the new industry is fully established and has financial resources and a good reputation behind it, then it can experiment with innovatory processes, but not just as it is establishing itself.

Annex 1

Tentative Scheme For the Development of Integrated Automotive Industry in the ESCWA Region

Product	Size of market	Plant size/year	Cost US$ mill.	Suggested Plan
1. Trucks & bus body	196,000 C.V 15,000 buses in 1990	Trucks 1000 bus 1000 others 1000	16.4	1) Allowing expansion of existing plants in Egypt Iraq, Kuwait & Saudi Arabia up to 10,000 units each 2) Build one new plant in non Gulf sub/region
2. Chassis	196,000 C.V. 15,000 buses in 1990	13,000	102	1) One plant in Gulf sub/region 2) The plant to be expanded progressively with the expansion of existing truck and assembly plants.
3. Engine valves	7 million 19 million with passenger cars in 1990 (spare market)	7 million	12.6	1) One plant in Gulf sub/region. 2) Another similar one at a later stage in non Gulf sub/region
4. Clutch plates & brake lining	1 million of plates and 3000 tons of lining in 1900 which doubles if demand of passenger cars is added (spare market)	1.2 million clutch plate ass. & 2000 tons of brake lining	6.7	One plant of suggested capacity to serve the region market.
5. Automotive Gears (transmission & differential)	14,000 tons in 1990 (spare market)	2000 tons	20	One plant to serve spare market of the region. alternatively a larger plant of 5000 tons to supply the demand of existing truck and bus assembly plants.
6. PTO shaft & propeller shaft	less than 300,000 units in 1990 (original equipment)	300,000 (viable plant)	96.2	To be developed only when the demand reaches the viable plant capacity size.

Annex 1

Product	Size of market	Plant size/year	Cost US$ mill.	Suggested plan
7. Steering, power steering	less than 100,000 units (original equipment)	100,000 (viable plant)	140	To be developed only when the capcities of truck and bus assemblies in the region exceed 100,000 units.
8. Shock absorbers	5 million in 1990 which doubles if demand of passenger cars is added (spare demand)	100,000	6.5	Two plants to be developed, preferably one in Gulf sub/region and the other in non Gulf sub/region.
9. Fuel injection parts	7 million in 1990 (spare demand)	6 million	40	One plant to serve the region market to be implemented in two stages, to start with 3 million.
10. Panel Instruments	less than 250,000 units (original spare demand)	250,000 (viable plant)	24	To be developed only when capacities of truck & bus assemblies in the region exceed 25,000 units.
11. Alternators, starters	above 100,000 units (original & spare)	100,000 (viable plant)	87	One plant to serve the region's market.
12. Windshield Glass	600,000 m^2 (original & spare)	300,000	39	One plant to serve the region market.
13. Gaskets	45 million pieces in 1990 going up to 120 million if passenger spare demand added (spare)	50 million pieces	1,6	Two plants to be developed, one in Gulf sub/region and the other in non Gulf sub/region.
14. Oil seals	7 million pieces in 1990, going up to 30 million with the spare demand of passenger cars (spare)	10 million	2.26	Two plants to be developed, one in Gulf sub/region and the other in non-gulf sub-region.

Annex 1

Product	size of market	Plant size/year	Cost US$ mill.	Suggested plan
15. Automobile rubber components (hoses V belts, brake hoses)	2.75 million pieces in 1990, going up to about 9 million with the spare demand of passenger cars (spare)	9 million	7.42	One plant to be developed to serve the regional market.
16. Wiper Motors	As original equipment approx. one per cent for spare	50,000 no.wiper motor, 150,000 no. wiper arm	1	One plant to be developed to serve the regional market, after the assembly/manufacture of trucks & buses in the region have developed considerably
17. Water pump assembly	300,000 (spare)	300,000	4	One plant to be developed to serve the region market.
18. Bimetal bearings	7 million pieces in 1990 going up to 12 million with the demand of passenger cars (spare)	5 million	10	One plant to be developed to serve the region market.
19. Radiators	more than 100,000 in 1990 for original and spare	100,000	3,5	Due to existance of several national projects. it is recommended to improve and expand the existing plants to meet the demand both as original and spare markets.
20. Under carriage	10,000 sets in 1985 (spare)	3,000 sets	-	One plant to be developed to serve the region market.
21. Cutting edges	150,000 sets in 1985 (spare)	1 0,000 sets	1.5	At least one plant to be developed to serve the region market.

Annex 1

	Product	size of market	plant size/year	Cost US$ mill.	Suggested plan
22.	Plastic components (tail lights, side lights)	several million pieces taking together the demand of passenger cars	50,000	1	At least two plants to be developed, one in the Gulf sub/region and the other in non-Gulf sub/region.

Part II
Project Profiles

This part of the study incorporates project profiles as candidate regional projects. Certain profiles, have been prepared in detail. Others, due to lack of resources are presented in a broad manner. Brief information with regard to some project ideas are also given.

It is to be understood, that the project profiles are only intended for the purpose of identification of investment oportunities in the region. Additional studies in the form of pre-feasibility and/or feasibility are essential prior to any investment decision.

1. Detailed Profiles

1.1 Truck and bus body building

1. Introduction

The yearly demand for trucks and buses as worked out in chapter III of this study is as:

Year	C.V	Buses
1985	166,000	12,000
1990	196,000	15,000
1995	231,000	18,000
2000	274,000	21,000

This justifies establishment of several manufacturing unit in the region. With due consideration to existing plants. A plant with the following capacity has been suggested:

- Trucks 1000 units p.a
- Bus body building 1000 units p.a
- Tankers and others 1000 units p.a

2. Manufacturing process

Individual types of coach is normally custom designed, however, it would be possible to bring out a certain amount of standardization for door frame, entry doors, interior fitments etc. The same is true in regard to other categories of vehicles perhaps, the unit proposed to have facilities for the following:

Parking of chasis received for assembly
Laying chasis in shed for building super structure
Panelling
Painting
Finishing with fittings
Production facilities of steel metal components, seats, upholstry, etc.

During the subsequent phase, provision could be made for expanding the sheet metal shop to improve panel and body designs and the volumes reach a level to justify investment on machinery.

Type of equipment

- Sheet metal machinery, power presses, shearing, brakes
- Drilling machines
- Gas and arc welding sets
- Painting units
- Butt welding units
- Mini Cranes
- Compressors
- Variety of hand tools and inspection tools

3. Capacity

- Trucks	1000 units p.a
- Bus body building	1000 units p.a
- Tankers and allied	1000 units p.a

4. Cost of project

	US$ (million)
- Land 20,000 sq.m @$20 per sq.m	0.4
- Building 5,000 sq.m @$800 per sq.m	4.0
- Plant and machinery	10.0
- Miscellaneous expenses	2.0
Total	16.4

5. Personnel

Designation	Salary p.m US$	No. of persons	Amount per month ($)
Divisional managers	4,000	10	40,000
Engineers	3,000	40	120,000
Draftsman	1,250	20	25,000
Foreman	1,250	24	30,000
Skilled workers	1,000	200	200,000
Unskilled/semi-skilled workers	600	150	90,000
Clerical	1,000	40	40,000
Total		484	545,000

(Total per year 6.54 million)

6. Turnover — US$45.0 million

7. Inputs required

- Materials and components (mild steel, cold rolled sheets, aluminium sheets, chequered plates, glasses, form rubber, rubber parts, resin, paintings surface treatment chemicals, hardware including fasteners, fittings, etc.). — 24.0
- Consumables — 1.0
- Power — 0.29
- Repair and maintenances — 0.6
- Salaries and wages — 6.54
- Mis. manufacturing expenses — 1.0
- Sales & service expenses — 3.0
- Interest expenses — 4.5
- Depreciation — 1.3

US$ (million)

42.23

(Profit before tax US$2.77 million)

1.2 Chassis

1. Introduction

The yearly demand for trucks and buses as worked out in chapter III, justifies the establishment of several manufacturing units for assemblying chassis suitable for both trucks and buses. A plant with the capacity of 13,000 chassis a year has been considered.

2. Description of product characteristics

Chassis frame

The frame is of ladder-type, where u-shaped side units are interconnected by riveted and bolted tubular cross-units.

Average width of chassis	2,180mm
Weight	6,000Kg
GVW	16,000Kg
Permissible axle load/front	6,500Kg
Permissible axle load/rear	9,500Kg
Turning radius	9,2 metre
Climbing capacity	17,5 degree
Max. speed	94 kmph

Suspension

Rear/front: Semi-elliptic leaf-spring
w/hollow rubber spring
w/shock absorber

Tire size: 11.00-20"
Wheel rim: 8,00-20" trilex

To be fitted with proper specification of

Clutch
Gear box
Propeller shaft
Rear axle
Front axle
Steering gear

3. Production process

(a) Production of chassis frame units:

- Cutting
- Welding
- Riveting
- Boring
- Surface treatment

(b) Assembly of chassis frame:

- Welding
- Riveting
- Adjusting
- Surface treatment
- Assy of main units, engine, axle, etc.
- Q.C.

(c) Auxiliary processes:

- Tools, jigs, fixtures manufacturing
- Maintenance of manufacturing equipment
- Storing
- Material handling
- Testing
- Data processing

4. Production equipment

The number of production equipment required are numerous, which includes:

- Cutting machines
- Drilling/boring machines
- Welding machines
- Riveting machines
- Special purpose machines
- Heat treating equipment
- Surface treating equipment
- Painting machines/booths
- Material handling equipment
- Testing equipment
- Machinery for producing jigs, fixtures and other auxiliary equipment and tools

5. Factory requirements

Land/total	120,000m2
Building/workshops	75,000m2
Warehouse	42,000m2
Other area	2,800m2
Utility/monthly	
Electricity	480,000Kwh
Water	16,000m3
Natural gas	27,000m3
Compressed air	1,880,000m3

6. Material:

Approximate material/ton/month/requirements are:

Castings	123
Forged parts	180
Rolled steel rods	126
Drawn steel section	112
Thin steel sheet	227
Thick steel sheet	247
Steel strip	10
Steel tubes	218
Rectangular/closed/shaped steel tube	710
Light metal	0.28
Non-ferrous metal	0.98
Fuel and lubricants	68
Paintings	36
Total	2,048

7. Manpower:

Skilled, semi-skilled and others	3000
Engineers, managers, administrative staff	450
	3450

8. Approximate cost of building, equipment, utility and labour

(a) Fixed capital (USD million)

Land 120,000m2	2.4
Building 75,000m2	75.0
Equipment	24.3
Fixed capital total:	101.7 M USD

(b) Variable cost (1000 USD per month)

Utilities

Electricity (480,000 Kwh)	24.0
Water (16,000m3)	4.8
Gas (27,000m3)	2.7
Compressed air (1,880,000m3)	376.0
Utilities total	407.5

Materials (monthly)

2,048ton/month	3.1 M USD
Average unit price	1,500 USD/t

Manpower (monthly)

skilled, semi-skilled(3,000)	3.6 M USD
Engineers, managers(450)	1.8 M USD
Total	5.4 M USD

Variable costs total: (M MUSD per month)

Utilities	0.408
Material	3.1
Labour	5.4
Variable cost total:	8.9 M USD

1.3 Engine valves

1. Introduction

Engine valves are used in internal combustion engines (4 stroke) as intake valves and exhaust valves. Hence two valves are used per cylinder. The finished component for either intake or exhaust valve is normally a single piece. Though the valve may be made out of a combination of materials. In certain cases combination of bimetal and stellite deposited valves are also used. The requirement of valves as spares is directly linked to the population of vehicles in use.

The demand for engine valves, even for the spares market as seen in chapter IV, exceeds 7 million in 1990 and 11.5 million in the year 2000. In case the requirement of passenger cars is considered, then the total demand exceeds 19 million in 1990 and 26 million by the year 2000. This quantum of demand is sufficiently large justifying establishment of local manufacturing facilities.

In fact there is scope for the establishment of more than one unit. A unit with an annual capacity of 7 million nos. would be an economically viable with almost all the machinery in different operations totally balanced. Engine valves being a component of the engine has to conform to rigid specifications not only in terms of dimensional accuracy, but also in regard to the metallurgical characteristics.

2. Technology

Manufacture of engine valves involves two distinct areas of technology - one relating to forging and another relates to precision machining, particularly grinding. In certain types of valves surface coating techniques like stellite weld and chrome plating are also involved. Although there are a number of manufacturing firms all over the world, the source of technology for their manufacture could be traced perhaps to half a dozen parent companies.

Broadly the manufacturing stages involved are:

- Preparation of bars into blank lengths
- Centreless grinding, friction welding wherever necessary
- Upset forging
- Deposit hard face wherever necessary
- Heat treatment
- Turning operations
- Grinding of the stem
- Hardening
- Hard chrome plating

3. Capacity per year

7 million valves

4. Cost of project	US$ (million)
Land 20,000 sq.m @$20 per sq.m (provision for expansion also provided).	0.4
Building 4,000 sq.m @$800 per sq.m	3.2
Plant and machinery	8.0
Miscellaneous expenses	1.0
Total	12.6

5. Personnel

Designation	Salary p.m US$	No. of persons	Amount per month ($)
Divisional managers	4,000	10	40,000
Engineers	3,000	20	60,000
Draftsman	1,500	4	6,000
Foreman	1,500	12	18,000
Skilled workers	1,000	100	100,000
Unskilled/semi-skilled workers	600	200	120,000
Clerical	1,000	40	40,000
Total		386	384,000p.m

(Total per year 4.6 million)

6. Turnover

($14 million)

7. Inputs required	US$ in million
Raw materials	3.0
Consumables	0.6
Power	0.2
Repair and maintenance	0.6
Salaries and wages	4.6
MIS. manufacturing expenses	0.6
Sales and service expenses	0.4
Interest	1.9
Depreciation	0.1
Total	12.0

8. Net profit before tax — US$ 2 million

1.4 Clutch plates and brake lining

1. Introduction

Clutch assembly is an important component of the transmission system. Normally there are two types of clutches used on vehicles, namely, diaphragm type and coil spring, type, which is generally known as the conventional clutch. In the clutch assembly, the clutch plates inclusive of the clutch facing requires periodic replacement. The replacement is generally related to the mileage/Km done by the vehicle. The clutch cover itself does not have any replacement demand.

The demand, as marked out in chapte IV, for clutch plates is of the order of one million pieces in 1990 and going up to 1.53 million pieces in 2000, and 3017 tons of clutch facing and brake lining in 1990, going up to 4202 tons in 2000. However, the demand figures, will double, if the requirement of passenger cars are considered as well. This large volume of demand justifies the establishment of a manufacturing unit for producing clutch plate assembly clutch facing and brake lining.

2. Technology/manufacturing process

The clutch plate for replacement consists of the clutch facing, which is rivetted on to cast iron hub along with other components like springs. Relatively manufacture of the metal components in the clutch plate involves less sophisticated technology. On the other hand, manufacture of brake linings and clutch facings involves technology of the medium order. In the case of clutch facings and brake linings the basic raw material is asbestos. Special attention has therefore to be given for pollution control arising out of asbestos fibre. The unit should also have adequate instrumentation facilities to assess the fibre level in the atmosphere. Manufacture of metallic components is essentially by conventional process involving machining, drilling, press work etc.. Items like springs are bought out item. In the case of clutch facing and brakelining, the main raw material, asbestos is mixed with appropriate resins and other additives to give desired strengh. Subsequently these are moulded. The moulded components are then baked to the prescribed temperature to give the desired hardness. Later these are remained to give accuracy and surface finish.

3. Capacity

Clutch plate assembly	1.2 million nos. per year
Brake lining and clutch facing	2000 tons per year

4. Cost of the project

	US$ in million
Land 10,000 sq.m @20$ per sq.m	0.2
Building 4,000 sq.m @$800 per sq.m	3.2
Plant and machinery	3.0
Miscellaneous expenses	0.3
Total	6.7

5. Personnel

Designation	Salary p.m US$	No. of persons	Amount per month ($)
Divisional managers	4,000	2	8,000
Engineers	3,000	4	12,000
Foreman	1,500	10	15,000
Technicians	1,500	6	9,000
Draughtsman	1,500	10	15,000
Skilled workers	1,000	70	70,000
Unskilled/semi-skilled workers	600	130	78,000
Clerical	1,000	20	20,000
Total		252	227,000p.m

(Total per year 2.72 million)

Turnover

($24.00 million)

6. Inputs required

	US$ in million
Raw materials and components	13.67
Consumables	0.72
Power 1500 Kw	0.22
Repair and maintenance	0.20
Salaries and wages	2.72
MIS. manufacturing expenses	1.20
Sales and service expenses	1.20
Interest	1.68
Depreciation	0.50
Total	22.11

(Net profit before tax US$1.9 million)

1.5 Automotive gears

1. Introduction

Automotive gears consists of broadly two group, namely transmission gears used in the gear box and the differential gears used in axles. These form the basic components in the power train of an automotive equipment. The number of gears in a gear box varies from 10 to 20 depending upon the category of the vehicle. In so far as the differential gear is concerned, it consists of a crown wheel and a pinion and 4 to 6 differential gears. As in the case of other selected automobile ancillaries the recommendation is to establish manufacturing facilities for production of these gears to meet the replacement demand. The major replacement requirement for either transmission gears or differential gears come from heavy duty vehicles particularly trucks/ which carry heavy loads. To a limited extent gears used on light commercial vehicles and tractors also call for replacement, although after long intervals.

2. Plant capacity

Production facilities required for the manufacture of gears would fall into two categories, namely, (a) machinery required for the manufacture of transmission gears, and (b) machinery required for the manufacture of differential gears. However, there are certain areas in the manufacturing operations such as turning, heat treatment, where common facilities could be utilised. Having regard to these factors it is recommended that the proposed unit should be a composite unit having facilities for the manufacture of transmission gears and differential gears.

The demand potential even for spares by 1990 works out to 14,000 tons which goes up to 19,000 tons by 2,000. This demand justifies the establishment of facilities for the manufacture of gears in the region. For that matter, scope exists for the establishment of several plants. A question could be raised whether it would not be more economical to establish one large unit catering to the total requirements. But overall economy does not get changed if the capacity of plant exceeds a certain capacity say, 5,000 tons per annum. Moreover, since the plant will have to cater to a large variety of gears there is no scope to introduce automation to any large extent, except what is inbuilt in the machines for automatic operations. Having ragard to the sophisticated nature of the product and the progressive training and experience the workers will have to gain. It is recommended that the plant may be set up with initial capacity of 2,000 tons which can go through expansion during the second and third phase, if

necessary, in steps of 1,000 to 2,000 tons as the case may be.

3. Manufacturing process

Broadly the manufacturing stages involved are:

- Blank preparation (automats)
- Soft machining (turning, front chuckers, broaching, gear cutting)
- Hardening (continuous carborising, seal quench unit)
- Hard machining (cylindrical grinder, internal grinder etc.)
- Super finishing (lapping and honing).

4. Capacity

(2,000 tons per annum)

5. Cost of the project	US$ in million
Land 20,000 sq.m @20$ per sq.m	0.4
Building 8000 sq.m @$800 per sq.m	6.4
Plant and machinery	10.6
Miscellaneous expenses	2.6
Total	20.0

6. Personnel

Designation	Salary p.m US$	No. of persons	Amount per month ($)
Divisional managers	4,000	3	12,000
Engineers	3,000	10	30,000
Supervisors	1,500	10	15,000
Technicians	1,500	10	15,000
Foreman	1,500	30	45,000
Skilled workers	1,000	150	150,000
Unskilled/semi-skilled workers	600	250	150,000
Clerical	1,000	20	20,000
Total		483	437,000p.m

(Total per year 5.24 million)

(Turnover US$ 20 million)

7. Inputs required

	US$ in million
Raw materials (alloy steel forgings)	4.0
Consumables (gear cutting tools, broaches, grinding wheels)	1.0
Power	0.3
Repair and maintenance	1.0
Salaries and wages	5.2
MIS. manufacturing expenses	1.2
Sales and service expenses	0.5
Interest expenses	3.0
Depreciation	1.6
Total	17.8

(Net profit before tax US$2.2 million)

1.6 PTO Shaft + Propeller Shaft

1. Introduction

The major demand for PTO shaft and propeller shaft comes from the manufacture of OE manufacture. A plant with a production capacity of about 300,000 units is considered, as a minimum viable economic capacity.

2. Description of product characteristics

The PTO Shafts and Propeller Shafts used in heavy and medium commercial vehicles, agricultural tractors and construction equipment are falling to the 1,250-11,200 Nm torque range. PTO Shafts have the following prime components:

- Universal-Joint Fork
- Splined Shaft
- Universal-Joint Centre Cross
- Bearing Shells
- Needle-Roller Bearing
- Tube
- Dust Cap (cover cap)

3. Production process

Production should be organized by prime components. Major characteristics of the prime components by manufacturing technology are:

- Universal Joint Fork
  Forged, medium speed steel
  Each PTO or propeller shaft have two outer and two inner forks
  Production should be made on automatic forging machines and on transfer lines

- Splined shaft
  Forged, medium speed steel
  Production should be made on automatic forging and machine and on special purpose machines

- Tubes
  Bought-in tubes should be manufactured on special purpose machines

- Caps/Dust, cover etc.
  Production should be made on hydraulic and eccenter presses

4. Factory requirements

Land (total)	
Building	60,000m2
of which production shop	30,000m2
warehouse	20,000m2
office, canteen, etc.	7,000m2
	3,000m2

Utility (monthly)

Electricity	
Water	3.0 GWh
Gas	50,000m3
	250,000m3

Material

Total material requirement corresponds to the production programme and estimated to be as:

Forged parts	77000 tons
Pipe steel	2384 "
Sheet steel	809 "
Bought in compount	4809 "
Total	85042 tons

5. Manpower

Skilled, semi-skilled	578
Engineers, managers, administrators	50
Total	638

6. Production equipment

Transfer lines	16 units
Jig-lathes	6 "
Boring machine (spec.)	3 "
Special purpose machines	3 "
Ribbing machines	10 "
Grinding machines (diameter)	6 "
Broaching machines	2 "
Multi-spindle boring machine	5 "
Cutting machines (sheet)	2 "
Hydraulic presses	2 "
Eccenter presses	2 "
Hardening (induction) equp.	7 "
Balancing equipment	15 "
Welding equipment (CO)	7 "
Welding equipment (spot)	15 "
Painting equipment	1 "
Washing equipment (component)	10 "
Robots	35 "
Assembly equipment	

7. Cost of land, building, equipment, utility and manpower

(a) Fixed capital (USD million)

Land (60,000m2)	1.2
Building (30,000m2)	30.0
Equipment	65.0
Fixed capital total	96.2

(b) Variable costs (1000 USD per month)

- Utilities

Electricity (3.0 GWh)		150
Water (50,000m3)		15
Gas (250,000m3)		25
Utilities total		190

- Manpower (US$ per month)

Skilled, semi-skilled, etc.	(578)	694
Engineers, managers	(50)	200
Total		894

- Material (1000 USD per month)

Total material cost	10,500

- Variable cost total (1000 USD per month)

Utilities	190
Labour	894
Material	10500
Variable cost total	11,584

1.7 Steering, power steering

1. Introduction

The major demand for steering, power steering comes from the manufacture of OE manufacture. A plant with the production capacity of about 100,000 units is considered as being a minimum viable economic capacity.

2. Description of product characteristics

Type	Type I	Type II
Torque on the output/rocker/shaft at 140 bars effective pressure:	2700 Nm	5100 Nm
Max. weight on steered axle	42 KN	70 KN
Max. permitted pressure	140 bars	
Angle of the steering gear	17,1:1 21,2:1	21:1
Min. travel of the output shaft	90	
Number of turns on input shaft steering wheel, required to turn off	4,43 5,30	5,25
Applicable grade of oil	Automatic transmission fluid	
Required pump flow (nominal)	9 litres + -10%	16 litres/min -10%
Min. pump flow at engine idling speed	5.5 litres/min.	9 litres/min.
Permissible operating temperature for short periods, max.	80 C 100 C	
Max. permitted pressure drop in the return line	3 bars	
Operating range of pressure Limiter valve	140-5 bars	
Outside adjusting angle range of the hydraulic end limiters in both directions within the minimum (90) travel of the steering drop arm	10 -10	
Max. angle movement of the jointed steering column during operation When tilting cab	30 80 -90	
Mass of steering gear	28Kg	38Kg
Oil capacity of steering gear	1,1 litres	1,5 lit

The suggested area of application of the proposed types of steering are:

- Medium-load vehicles and special-purpose commercial vehicles for use in tough conditions.

- Urban, suburban and long-distance buses.

- Vehicles with a tilting cab.

Type I, has a lower performance and no adjustable hydraulic limiter.

Type II, has a higher performance and an adjustable hydraulic limiter.

The units in a variety of designs offer a range of possible methods of installation.

3. Production process

The production process must be suitable for manufacturing several steering models. It is assumed that feeding pumps and steering columns are not to be manufactured by this plant. These items will be bought-in components. Likewise forged and cast iron components will be bought-in components too.

There are separate manufacturing and assembly lines in one shop.

The main manufacturing processes are:

- Machining components and subcomponents
- Heat treatment
- Assembly
- Q.C.
- Adjusting

Auxiliary process are:

- Tools, jigs, fixtures mfg.
- Operation maintenance
- Material, semi-finished and finished parts transportation
- Storage
- Laboratory test
- R+D centre
- Computer centre

4. Factory requirements

Land total	40,000m2
Building	20,000m2
Utility (per month)	
Electricity	1,985,000KWh
Water	25,000m3
Gas	210,000m3
Compressed air	1,165,000m3

Approximate material requirement

	ton/month
Casting	200
Forged parts	150
Rolled, drawn material	180
Sheet	5
Bought-in	65
Total	600

5. Production equipment

Major productive and auxiliary machinery are:

- Transfer lines
- Presses
- Heat treating equipment
- Surface treating (washing) equipment
- Other equipment (auxiliary machinery a.c equipment e.t.)

6. Manpower

- Skilled, semi-skilled, etc.	2000
- Engineers, managers, adm.	500
Total	2500

7. Cost of land, building, equipment, utility

(a) Fixed capital (USD million)

Land (40,000m2)	0.8
Building (20,000m2)	20.-
Equipment	118.4
Total	139.2

(b) Variable costs (1000 USD per month)

- Utilities

Electricity	(1,985,000 KWh)	99.2
Water	(25,000m3)	7.5
Gas	(210.000m3)	21.0
Compressed air	(1,165,000m3)	233.0
Utilities total		360.7

- Manpower (1000 USD per month)

- Skilled, semi-skilled, etc. (2000)	2,400
- Engineers, managers (500)	2,000
Total	4,400

- Material

1000 USD per month	510

Viable cost total (USD 1000 per month)

Utilities	360.7
Labour	4,400.-
Material	510
Total (USD 1000 per month)	5270.7

1.8 Shock Absorbers

1. Introduction

Shock absorbers form part of the suspension system of vehicle to dampen the oscillations so that the vehicles could have a smoother drive even over uneven surface. Additionally shock absorbers assist in reducing the wear and tear of tyres, breakage to suspension parts, proper road holding. A shock absorber also help in improving the fuel consumption of the vehicles by keeping the tyres constantly in touch with the road. Shock absorbers are of different types and the most common are:

- Hydraulic telescopic
- Hydraulic telescopic with additional use of pneumatic
- Mopherson Struts
- Frictional dampers

Out of the above, the more popular one is the hydraulic telescopic type. The oscillations/vibrations are dampened by allowing restricted flow of oil through orifices and spring loaded valves.

The demand as worked out in chapter IV, is of the order of 5 million pieces in 1990 and going up to 7 million in 2000. If the requirement of passenger cars are considered, the demand will almost doubles.

2. Plant capacity

The estimated demand for shock absorbers justifies the establishment of local manufacturing facilities. Two options have been considered: One a plant having an annual capacity of 5 million shock absorbers, and the other one is a plant having a capacity of only 100,000 shock absorbers of a modular type.

3. Plant capacity of 5 million

3.1 Manufacturing process

The shock absorber consists of a number of components and it is common practice that some of the components are obtained from specialised manufacturers. The main bought out components are springs, oil seals and certain die cast components. The manufacturing process involves the following:

- Blank preparation from tubes
- Pickling and cleaning
- Manufacture of pistons, from piston rods including hardening, plating and greasing
- Manufacture of valves and sub-assemblies thereof

- Piston and rod assembly
- Oil filling
- Shock absorber assembly
- Testing
- Mounting assembly
- Painting

Among the automobile components, technology required for the manufacture of shock absorbes would come under the category of medium technology.

3.2 Cost of project

	US$ Million
Land 20,000 sq.m @$20 per sq.m	0.4
Building 6,000 sq.m @$800 per sq.m	4.8
Plant and machinery	7.5
Others	2.0
Total	14.7

3.3 Personnel

Designation	Salary p.m US$	No. of persons	Amount per month ($)
Division managers	4,000	6	24,000
Engineers	3,000	15	45,000
Draftsman	1,500	10	15,000
Foreman	1,500	12	18,000
Skilled workers	1,000	100	100,000
Unskilled/semi-skilled workers	600	400	240,000
Clerical	1,000	40	40,000
Total		383	482,000p.m

(Total per year $ 5.76 million)

3.4 Turnover $ 30 million

3.5 Inputs

- Tubes (electric resistant welded and seamless) 9.0

- Piston and die cast components	
- Oil seals and oil rings	
- Sintered iron components	
- Consumables	2.0
- Power 1500KW	2.2
- Repair and maintenance	0.5
- Salaries and wages	5.8
- Misc. manufacturing expenses	2.0
- Sales and service expenses	1.0
- Interest expenses	3.0
- Depreciation	1.2
Total	26.7

(Net profit before tax 3.3 million)

4. Plant capacity of 100,000 units

The project underlined is a modulor plant which produces 100,000 units a year in 2x8 hour shift. In order to meet higher demand, several modulor unit projects may be set up.

4.1 Production process

Components to be manufactured can be grouped according to their similarity of shape and technology:

Tubular shaped components

- Tubes
- Piston rods
- Components produced by powder matallurgical process
- Cover lid for tank pipe
- Piston-rod nut
- Cap screw
- Throttle valve
- Sleeve
- Return pipe
- Packing case
- Spring holder

Several other parts should be used as bought-in components, such as:

- Springs
- Cold-processed/trimmed, pressed/components
- Rubber goods
- Other commercial parts and materials

The manufacture of the components requires an up-to-date/ automatic, semi-automatic, programme controlled, CNC/machinery. When assorting the machines, it has been considered the demand for adjustability of the stroke selected. For the production line to be installed, it has been considered the possible deviations in geometry and dimensions of the components, as well. This tolerance exists for the finishing of tubular parts, for the manufacture of cover lids for tank pipes and piston rods. Hard-chromium-plating of the piston rods should happen in separate area in order to keep sanitary and labour safety stipulations.

Those machines and equipment, e.g. (milling machines) which are necessary for processing several parts, will be installed at a point of the material flow rout where their accessibility is optimum from the material handling line. The finished parts will be carefully cleaned and degreased prior to assembly. This operation is to be carried out for parts of small mass and dimension in solvent system (trior perchloroethylene), while for cleaning the tubes and covers lids for tank pipe semi-automatic device applying alkaline wash.

The assembly happens by the help of special machines designed for the individual fitting phases, of electro-pneumatic operation. Vital moment of the assembly is the filling up with oil, for which operation there are two solutions:

- Central oil feeder
- Oil supply from storage barrels

The erection of a central oil feeder represents the more up-to-date solution, while the relative expenses are higher. Shock absorbers assembled must be tested on a stand where damping force both in direction of pull and compression strokes can be safely determined.

After the bench test, the shock absorbers will be transferred to electrostatic dyeing equipment and then to drying chamber. The ready-made shock absorbers will be transported to their destination in adequate packing.

4.2 Factory requirements

Land	2.500m2
Building	1.700m2
Utilities	

Electricity	51.200KWh/per month
Compressed air	25.600m3 per month
Water	51.200m3 per month

Calculation of raw-material

Finished weight of product (Kg per unit)	10
Material yield (per cent)	80
Material weight (raw material and bought-in (Kg per unit)	12,5
Daily production (units)	392
Material requirement (Kg per day)	4900
Material requirement (20 day X 4900) tons per month	98

4.3 Production equipment

Tube cutting device	1	Unit
Tube deburring device	1	"
Heading machine	1	"
Tank pipe processing special machine	1	"
Special purpose machine for tube expanding	1	"
CO2 automatic welding machine	1	"
Surfacing-centre punching machine	1	"
Special purpose machine for piston rod cutting	1	"
CNC lathe	3	"
Threading machine	1	"
Milling machine	3	"
Centre-less grinding machine	1	"
Plain milling machine	1	"
Special mantle polishing machine	1	"
Piston and cover lid surfacing machine	2	"
Drilling machine	1	"
4-spindle drill	1	"
Bench drill	2	"
Turret lathe (automatic)	3	"
Special purpose machine for the production of return pipes	1	"
Drill press	1	"
Centre-less grinding machine	1	"
Programme controlled lathe	2	"
Finishing-surfacing machine	1	"
Copying lathe	1	"
Special surfacing-mantle machining lathe	1	"
Automatic turret lathe	1	"
Assembly devices, mounting department	4	"
Chroming equipment	1	"
Decreasing, washing devices	4	"
Dyeing unit	1	"
Test bench	4	"
Instruments for production, assembly	several	
Transport and storage equipment	"	

4.4 Cost of land, building, equipment, material

(a) Fixed capital	
Land (2.500m2)	50,000USD
Building (1.700m2)	1,700,000USD
Equipment	3,840,000USD
Fixed capital	6,5 USD million
(b) Variable costs (monthly)	
Utilities	
Electricity	2.560USD
Compressed air	5.120USD
Water	15.360USD
Raw material	147.000 USD
Labour cost	124.000 USD
Variable cost	294.040 USD

4.5 Manpower required

Skilled	32
Unskilled	38
Engineers	8
Office clerk	2
Total	80

1.9 Fuel Injection Equipment

1. Introduction

Fuel injection forms the heart of diesel operated equipment. As indicated in chapter IV, each of the replacement component of fuel injection equipment, nozzles, elements and delivery valves works out to about 7.4 million sets in 1990, and eventually going up to 10.5 million sets in 2000 AD. The above demands are sufficiently large justifying establishment of manufacturing facilities, perhaps more than one, with balanced lines of capacities. There are two options in this connection. One would be to plan for a single unit which would eventually cater to the total demand of these spares. Alternatively, at least 2 to 4 units could be planned in different locations preferably with technology coming from 2 or more independent sources. The latter suggestion merits preferential consideration for more than one reason. In the first place, the technology for the manufacture of fuel injection equipment is sophisticated and is held by a few firms in the international field. The gestation period to assimilate the technology is fairly long going upto 5 to 7 years. In such a situation it may not be prudent to make all the investments at one place or in one unit. What is even more relevant is that doubling or tripling of the capacity do not bring about significant changes in economic factors leading to higher profitability. Having regard to these factors, a model unit with 4 lines of production is recommended. Each of these lines will have a capacity of half a million units of each of the components on two shift working. Each of the line is fully balanced and is capable of duplication for identical capacities. It is recommended that during the first phase two lines be established.

2. Technology

The manufacture of the above components involves modern technology, specialised equipment and employment of highly skilled labour and well experienced supervisors, not to mention about the high quality of management the company should have, to make the venture a successful one. Broadly the manufacturing stages involved are:

- Blank preparation (automats)
- Soft machining (fun drill, micro hole drilling, etc.)
- Heat treatment (sealed quenchy-vaccum hardening, etc.)
- Hard machining (cylindrical grinder, internal grinder, surface grinder, etc.)
- Super finishing (lapping, honing, etc.)
- Matching and assembly (selective assembly)

3. Capacity

Nozzles	2 million nos. per annum
Elements	"
Delivery valves	"

(the above capacity will be implemented in 2 stages of 1 million sets of each).

4. Cost of project

	$ (million)
Land 40,000 sq.m @ $20 per sq.m	0.8
Building 15,000 sq.m @ $800 sq.m	12.0
Plant and machinery	24.0
Miscellaneous expenses	3.2
	40.0

5. Personnel

Designation	Salary p.m US$	No. of persons	Amount per month ($)
Division managers	4,000	5	20,000
Engineers	3,000	20	60,000
Supervisors	1,500	20	30,000
Technicians	1,500	20	30,000
Foreman	1,500	60	90,000
Skilled workers	1,000	300	300,000
Unskilled/semi-skilled workers	600	500	300,000
Clerical	1,000	40	50,000
Total		965	880,000p.m

(Total per year $ 10,560,000)

6. Turnover

(US$ 36 million in the 5th year of production)

7. Inputs required

	$ million
- Raw materials (alloy steel)	2.0
- Consumables	4.0
- Power 3000KW	0.5
- Repair and maintenance	2.0
- Salaries and wages	10.6
- Misc. manufacturing expenses	2.2
- Sales and service expenses	1.0
- Interest expenses	6.0
- Depreciation	3.2
Total	31.5

8. Net profit before tax 4.5

1.10 Panel instruments

1.1 Introduction

Panel instruments are produced as original equipment and as aftermarket component. The volume of production considered, is about 250,000 units for commercial vehicles, agricultural tractors and construction equipment. The following instruments - as basic instruments have been considered for production:

- Measuring/reading/instruments/cross-coil system/

  Thermometer
  Fuel gauge
  Pressure gauge
  Voltage meter

- Measuring/reading/instruments/Moving-coil "Deprez" system/

  Tachometer and odometer Rpm-meter
  Rpm-meter
  Rpm and operation-hour meter
  Pressure switch/oil-pressure, brake-air pressure/

- Transmitters for

  Tachometer and odometer/generator/
  Rpm-meter/generator
  Thermometer
  Fuel gauge
  Pressure gauge

2. Description of product characteristics

2.1 Measuring/reading/instruments/cross-coil system/

2.11 Thermometer

12/24 V., dia: 52/60mm
Reading of: coolant temperature
Lubricant temperature
Piston head temperature
40-120C or 60-200C

2.12 Fuel gauge
12/24 V, dia: 52/60mm
Reading intervals: E,F, 1/2 or O, 4/4, 1/2

2.13 Pressure gauge
12/24 V; dia: 52/60mm
Reading of: lubricant and brake-air pressure
Reading intervals: 0-6 bars
0-10 bars

2.14 Pressure gauge
12/24 V; dia: 52/60mm
Reading of: instant voltage of electrical circuit, charging voltage
Reading intervals: 12-14,8 V
24-29,5 V

2.2 Measuring/reading/instruments/Moving-coil "Deprez" System

2.21 Tachometer and Odometer
12/24 V; dia: 100/140mm
Reading intervals: 0-60 kmph
0-90 kmph
0-120kmph

2.22 Rpm-meter
12/24 V; dia: 100mm
Reading intervals: 0-3000rpm

2.23 Rpm-meter and operation-hour meter
12/24 V; dia: 100mm
Reading intervals: 0-3000rpm
0-9999.9 hr

2.24 Pressure switch
12/24 V;
Operates: Lubrication and brake-air pressure instruments
Operation intervals: 0,5-4 bars
4-6 bars

2.3 Transmiters

2.31 For tachometer and odometer/generator/
12/24 V, AC generator; aluminium housing
Max rev.: 3000 rpm

2.32 For rpm-meter/generator
12/24 V AC generator;
Aluminium housing
Max. rev.: 3000 rpm

2.33 For thermometer
12.24 V W/thermistor sensor

2.34 For fuel gauge
12/24 V
Min. fuel level: 1/6-1/10 of warning level/ total tank capacity

2.35 For pressure gauge
Proof: 30 bars

3. Production process

Major kinds of process are:

- machining
- stamping
- heat treating
- processing thermoplastic material
- pressure casting of aluminium
- surface finishing
- painting

4. Factory requirements

Land: 28,000m2

Building(m2):	
Component manufacturing shop	2,000
Surface finishing shop	500
Assembly shop	4,000
Auxiliary shops	500
Warehouse	2,000
Office	1,500
Social buildings	3,500
Total	14,000

Material (tons per year)

Steel sheet	160
Steel strip	80
flat steel	17
steel bar	75
spring steel	1
copper bar	25
copper strip	10
brass strip	1
copper coil/enameled	5
aluminium strip	15
aluminium sheet/plastic coated	25
aluminium casting	55
plastic casting	45
Zn-Alu casting	15
rubber plate	2
Total	531 tons

5. Production equipment

(a) For component production (units)

Eccentric presses	25
Aut. lathes	25
Boring machines (medium)	30
Thread cutting machines	10
Table press (pneumatic)	40
Pneumatic hand-tools	40
Wire winding machines	10
Six-spindle aut.lathes	5
Hydraulic presses	3
Injection moulding machines	3
Annealing furnaces	3
Centreless grinders	3
Multiple pulling machines	2
Vibration grinder	3

Other equipment like:

Capstan lathes
Watchmaker's lathes
Tappers
Milling machines
Special purpose machines
Welding machines
Rectifiers
Blanking machines
Aluminium die-casting machines

(b) Equipment for Assembly Line

Pneumatic bench-top presses
Different special assembling equipment
Assembly belts
Assembly benches and chairs
Winding machines
Ultrasonic welding machines
Planet bending machines
Foil printing machines
Bending machine
Electronic balances
Different controlling, calibrating tools
Different electrical and pneumatic small machines
Storing racks
Material handling equipment

(c) Auxiliary Equipment

Lathes
Milling machines
Surface grinders
Centre grinders
Universal tool grinders
Annealing furnaces
Planer
Filers
Spark cutting machine
Compressors
Air cleaners
Boilers
Transformers
Trolleys

6. Manpower:

Skilled, semi-skilled and other	970
Engineers, managers and administration staff	210
Total	1180

7. Approximate cost of land, building, utilities, material, labour and product equipment

(a) Fixed capital (USD million)

Land (28,000m2)	0,56
Building (14,000m2)	14,00
Equipment	9,12
Fixed capital total	23,68

(b) Variable cost (1000 USD) Monthly cost

Utilities	
Electricity (167,000 Kwh)	8,4
Water (5,000m3)	1,5
Total utilities (rounded)	10,0
Materials (44 tons)	66,0
Labour:	
Skilled, semi-skilled (970)	1,164
Engineers, managers (210)	840
Total labour	2,004
Variable cost total:	2,080

1.11 Alternators, Starters

1. Introduction

Alternators and starters are produced as original requirement and as aftermarket component. The volume of production considered is in the range of 100,000 units which is considered as minimum viable capacity. Two different models have been considered to be manufactured from each of the products to meet the need of end use equipment.

2. Description of product characteristics

(a) Starter

- IM-35 axial type (3Kw, 12 V)-fits tractors
- IM-300 with coaxial pinion advance (5,5 Kw, 24V) fits trucks and buses.

(b) Alternator

- VG-300 with built-in regulator (45 A, 14V) fits tractors and trucks.
- VG-900 with built-in regulator (100 A, 28V) fits buses.

3. Production process

Major kind of process categories:

- Cutting
- Grinding
- Milling
- Tapping, threading
- Pressing
- Heat treating
- Winding (wire)
- Assembly

4. Factory requirements

Land (m2)	
Building (m2)	60,000
Production plant, maintenance shop tool room after sales and service dept.	25,000 m2
Warehouse	13,000 "
Office	3,000 "
Total:	41,000m2

Utilities

Electricity/Kwh per month/	50,000
Water/m3 per month/	50,000
Material	
Steel	8,750 tons per year
N.F. metals	1.190 "
Plastics	300 "
Silver	0,05
Electronic components	1,54 USD million per year

5. Production equipment

Major production and auxiliary equipment are:

Lathe	150 Units
Grinder (automatic)	40 "
Mill	20 "
Threading machine	100 "
Machining centre	4 "
Rapid press	4 "
Line press	4 "
Cam-press, Hydr. press	150 "
Heat treating furnace	10 "
Pig machine (for Alu.)	6 "
Surface treating machine	4 "
Winding (wire) spec. purp. machine	50
Assembly line equipment	8 "

6. Manpower:

Skilled, semi-skilled and others	2100
Engineers, managers and administratives	500
Total	2600

7. Approximate cost of land, building, equipment, utilities and material

(a) Fixed capital (USD million)

Land (60,000m2)	1,2
Building (41,000m2)	41,0
Equipment	45,0
Total fixed capital	87,2

(b) Variable costs (1000USD) Monthly cost

Utilities	
Electricity (Kwh)	2,5
Water (m3)	15,0
Utilities total	17,5
Materials	
Steel (729 tons)	1,100
N.F. metals (100 tons)	170
Plastics (25 tons)	38
Silver (0,0042 tons)	1
Electronic components	128
Materials total	1,437
Manpower	
Skilled, semi-skilled (2100)	2,520
Engineers, managers (500)	2,000
Total labour cost	4,520
Variable costs (total)	
Utilities	17,5
Materials	1,437,0
Manpower	4,525,0
Variable total	5,979,5

1.12 Windshield Glass

1. Introduction

Windshield glasses are normally of two different qualities such as:

- tempered glass
- laminated safety glass

Therefore both tempered and laminated glass should be manufactured in:

- "flat" and
- "bent" form

The volume of production which has been considered is:

- tampered glass	200,000m2
laminated safety glass	100,000m2

Which is considered as minimum viable capacity.

Manufacturing plant to run 260 days a year in 2X8 hour shift per day. Production is continuous at tempered and laminated bent lines, while laminated glass line runs in 2X8 hour shift.

2. Description of product characteristics

Tempered glass is a single-layer (usually 5-6mm thick) glass in which during the tempering process - heating into the transformation range and rapid cooling - the flexural strength is 6-8 times higher than the normal glass and it has a better heat shock resistance. While breaking it disintegrates into very small parts.

Laminated safety glass consists of a hard plastic layer sealed under heat and pressure between two sheets of glass. The layer is of polivinylbutyral (PVB) which adheres strongly and permanently to glass. Under impact, laminated glass cracks but remains integral. A cobweb pattern extends from the point to the interlayer.

3. Production process

3.1 Tempered glass plant

3.1.1 Flat windshield and flat side window glass shop

- Sheet glass preparing
- Cut to size and shape
- Grinding
- Drilling (as required)
- Washing
- Tempering (heating and air-cooling)
- Packing

- Storage
- Delivery

3.1.2 Bent windshield and rear window glass shop

- Sheet glass preparing
- Cut to size and shape
- Grinding
- Drilling (as required)
- Washing
- Tempering (heating, bending, air-cooling)
- Packing
- Storage
- Delivery

3.2 Laminated glass plant

3.2.1 Flat windshield and flat side window glass shop

- Sheet glass preparing
- Cutting
- Edge grinding
- Washing
- Powdering
- Cleaning
- Assembling (adding PVB)
- Pre-laminating (under pressure)
- Autoclave
- Packing
- Storage
- Delivery

3.2.2 Bent windshield rear window glass shop

- Sheet glass preparing
- Cutting
- Edge grinding
- Washing
- Powdering
- Bending
- Cleaning
- Assembling (adding PVB)
- Pre-laminating (vaccum treatment)
- Autoclave
- Packing
- Storage
- Delivery

3.3 Auxiliary shops

3.3.1 Sheet glass preparing shop (for plants 3.1 & 3.2)

3.3.2 Packing, storage and rack-making shop

3.3.3 Maintenance shop

3.3.4 Mould producing and maintenance shop

3.3.5 Forklift truck battery charging and filling station

3.3.6 Quality control laboratory

4. Factory requirements

Land total:		97,000m2	
Building :			
Plant 3.1 and 3.2 (total)		5,700m2	
Shop 3.3.1 (total)		4,300m2	
storage:	2,500m2		
pre-cut:	1,800m2		
Shop 3.3.2 (total)		15,100m2	
packing:	800m2		
storage:	3,600m2		
rack-making	4,200m2		
lumber-store:	1,500m2	(could be open-air)	
rack-store:	5,000m2	(could be open-air)	
Shop 3.3.3 Maintenance		3,000m2	
Shop 3.3.4 Mould shop		2,550m2	
Shop 3.3.5 Forklift truck		1,000m2	
Shop 3.3.6 Q.C. lab.		500m2	
Total		32,150m2	

Utility

	Electricity (KW)	Compressed Air 6-8 bar (m3/hr)	Water 20c (m3/hr)
Plant 3.1	2,200	100	150
Plant 3.2			
Shops 3.3	400	60	-
Total	2,600	160	150

Material (per annum)

- Plant 3.1 and 3.2:	Sheet glass 3mm	300,000m2
	Sheet glass 5-6mm	350,000m2
	PVB film	130,000m2
- Shops 3.3:	Paper, PS form, rubber sheet 2,500m3 lumber p.a (for approx. 50,000 racks).	

5. Production equipment

5.1 Equipment of tempered glass plant

1. Pantograph cutting machine	10	Unit
2. Edge grinding machine (twin belt)	2	"
3. Grinding machine with diamond wheels	3	"
4. Glass cutting machine	1	"
5. Glass drilling machine	2	"
6. Horizontal glass tempering oven	1	"
7. Bent glass tempering oven	1	"
8. Pre-drilling machine for tong marks	1	"
9. Washing machine	2	"

5.2 Equipment of laminated glass plant production line for bended glasses

1. Preparing production line

1.1 Pantograph cutting machine	2	Unit
1.2 Break-out table	2	"
1.3 Edge grinding machine (twin belt)	2	"
1.4 Glass washing machine	1	"
1.5 Powdering unit	1	"

2. Serial glass bending furnace	1	"
3. Individual glass bending furnace (for short series and for testing)	1	"

4. Cleaning - assembling conveyor		
4.1 Cleaning station	1	Unit
4.2 Assembling station	1	"
4.3 Lifting station	1	"
4.4 Conveyor	1	"
5. Vacuum conveyor	1	"
6. Autoclave and accessories	1	"

Production line for flat glass products

7. Edge grinding machine (twin belt)	1 "
8. Glass washing machine	1 "
9. Pressing unit (autoclave according to the point 6)	1 "

Unit for PVB-film treatment and storage

10. PVB-film storage room with air-cooling	1 "
11. Mobile cooled PVB-film box	4 "
12. Climate-room	

5.3 Equipment of auxiliary shops

5.3.1 Sheet glass preparing shop

Crane (5 ton)	1 "
Diesel forklift truck (3 tons)	2 "
XY system cutting machine: max.250x350cm sheet size, min. 8X8cm cutting size thickness 2-6mm with accuracy-0,5mm	2 "
Pantograph system cutting machine: max. glass sheets: 150x220cm	5 "
max. glass sheets: 100x150cm	5 "
Hand-operated cutting table: with 200x250cm sheet size	2 "
Conveyor for the cutting machines	2 lines
Electric forklift truck (2 tons)	2 Units
Delivery rack (1,2 tons)	200 "
Hand-operated truck with hydraulic jack (2 tons)	10 "
Cullet container (0,25m3)	50 pieces
Glass rack (built-in)	100 meters

5.3.2 Packing, storage, rack-making shop

Strapping machine	
Staplers	
Hand tools	
Diesel /or electric/fork lift/1-3 tons/	6 Units
Hand-operated cart (with hydraulic jack)	8 "
Conveyor (mobile)	5 "
Mobile truck crane (5 tons)	5 "
3 ton diesel side forklift truck	1 "
5 ton front forklift truck	2 "
Split band saw	1 "
Trimmer saw	2 "
Cut-off saw	1 "
Planer	2 "
Band saw	1 "
Pneumatic staple making machine	15 "
Wooddust separating cyclone	2 "
Bench for nailing	10 "

Sharpening machine	1	"
Band saw welder	1	"

6. Manpower:

	shop 3.1	shop 3.2	shop 3.3
Skilled, semi-skilled and others	108	108	261
Engineers, managerials and others	12	12	26
Total	120	120	120

7. Cost of land, building, equipment, utility (USD million)

(a) Fixed capital

Land (97,000m2)	1,94
Building (32,150m2)	32,15
Equipment	4,96
Total	39,05

(b) Variable costs (1000 USD)

Utilities (monthly)

Elctricity (832,000 Kwh)	41,6
Compressed air (51,200m3)	10,2
Water (48,000m3)	14,4
Utilities total	66,2

Labour (1000 USD) monthly

Skilled, semi-skilled (216)	259
Engineers, manager (53)	212
	471

Material (monthly

Sheet glass (3mm) 25,000	50
Sheet glass (5-6mm) 30,000	114
PVB film	40
Lumber	15
Total material	219

1.13 Gaskets

1. Introduction:

Gasket is a static sealing media used between 2 machined or formed surfaces to prevent leakages of the fluids within. Gaskets can generally be classified into two general types:

1. Metallic gaskets such as cylinder head gaskets where a thin metal such as copper or tin plate is used to prevent burning of the soft material such as asbestos.

2. Soft gaskets used in cylinder head cover, oil pan, gear boxes, water pump etc.

The demand, as worked out in chapter IV, for all types of gaskets is of the order of 45 million pieces in 1990 and going up to 67 million pieces in the year 2000. However, if the requirement of passenger cars is considered, then the demand exceeds 120 million pieces in 1990. This large volume of demand justifies establishment of several manufacturing units in the ESCWA region. A unit with an annual capacity of 50 million gaskets is suggested which is considered a viable one.

2. Manufacturing process:

Soft gaskets are usually punched out. In the case of hard gaskets the operations involved are punching separate layers, forming, assembly and closing and fitment of eyelets to mention the more important operations. Relatively the technology involved is low to medium technology. Particularly in the case of cylinders head gaskets, the product has to withstand high temperature and pressure measuring perfect sealing between cylinder head and cylinder block. Raw material selection and appropriate forming technology, therefore, play an important role in the manufacture of these gaskets.

3. Capacity — 50 million pcs per annum

4. Cost of project

	$ million
Land 10,000 sqm @ $20 per sqm	0.2
Building	0.80
Plant and machinery	0.4
Miscellaneous expenses	0.2
	1.6

5. Personnel

Designation	Salary P.M $	No.	Amount ($)
Divisional manager	4,000	1	4,000
Engineer	3,000	1	3,000
Foreman	1,500	2	3,000
Skilled workers	1,000	10	10,000
Unskilled workers	600	20	12,000
Total per year ($0.384 million)		34	32,000

6. Turnover $ 7.5 million

7. Inputs

	$ million
Raw materials (cold rolled copper strips, cold rolled steel strips, tin plate, asbestos/paper sheets, cork rubberised cork, compressed asbestos fibre jointing beater treated asbestos)	4.88
Consumables	0.22
Power 200 KW	0.05
Labour	0.38
Misc. manufacturing expenses	0.05
Repairs and maintenance expenses	0.05
Interest	0.30
Depreciation	0.10
Total	6.03

Net profit before tax (1.47 million)

1.14 Oil seals

1. Introduction

Oil seal is a rubberised metal component used in machinery items, particularly automotive equipment, to prevent oil leakage under high pressed and temperature conditions. The specification of oil seals both in terms of material specifications and dimentional accuracy are very stringent. From a safety angle, oil seal is a critical production and any unexpected failure therefore could lead to accidents. Oil seals are of different types, sizes and specifications depending upon the type of vehicle they are fitted in. These have regular replacement market.

The demand, as worked out in chapter IV, is of the order of 7 million pieces in 1990 and going up to 10 million pieces in the year 2000. But if the requirements of passenger cars are considered, then the demand exceeds 30 million by 1990. This large demand justifies establishment more than one plant. A unit with an annual capacity of 10 million oil seals is considered.

2. Technology and process of manufacture

As already stated oil seal is essentially a product involving two technologies, namely, rubber technology and metal working technology. The metal components are press formed and machined to give the desired accuracy. They are then bonded with rubber compounds and machined again to required specifications. Considerable advancement has been made in the rubber compounding technology using varieties of rubber chemicals, synthetic rubber and application of silicones in the manufacture of rubber components. It will therefore be seen that oil seals through relatively a low priced product, involves in its manufacture

3. Capacity (10.0 million nos. per year)

4. Cost of project

	$ million
Land 3000 sqm @ $20 per sqm	0.06
Building 1000 sq.m @ $800 per sq.m	0.80
Plant and machinery	1.20
Misc. expenses	0.20
	2.26

5. Personnel

Designation	Salary p.m	No.	Amount ($) p.m
Divisional manager	4,000	2	8,000
Engineer	3,000	5	15,000
Foreman	1,500	10	15,000
Technicians	1,500	8	12,000
Skilled workers	1,000	30	30,000
Unskilled workers	600	50	30,000
Clericals	1,000	12	12,000
Total		117	122,000

Total per year ($0.384 million)

6. Turnover $ 5.0 million

7. Inputs

	$ million
Raw materials	1.75
Consumables	0.35
Sales and wages	1.46
Repairs and maintenance	0.08
Power 300 KW	0.06
Misc. manufacturing expenses	0.10
Sales and services	0.10
Interest	0.40
Depreciation	0.16
Total	4.46

Net profit before tax (0.54 million)

1.15 Automobile Rubber Components

1. Introduction

Automobile rubber components as applicable to automotive equipment covers a very wide range of items starting from the simplest to the sophisticated. Items like rubber mats, radiator hoses, extrusions would come under the former category. Brake hoses and rubber to metal components, V-belts come under the latter category. Hoses for radiators, V-belts for fans are fast moving items in the spares market and to a lesser extent this is also true of brake hoses and rubber to metal bushings.

As indicated in chapter IV, the replacement demand for hoses, V-belts and brake hoses related to commercial vehicles, tractors amounts to about 2.75 million pieces in 1990 and 4.0 million in 2000. But if the requirement of passenger cars is considered then the demand will be over three folds of these figures.

2. Technology and process of manufacture

As already stated, manufacturing technology for the production of hoses for brake assembly, V-belts and rubber to metal components is of sophisticated nature. Moreover 'brake hoses' is of a critical safety item in an automotive equipment. The manufacturing process generally consists of preparation of rubber with additives, chemicals and synthetic rubber, mouldings, curing inspection and packing.

3. Capacity

Brake hoses (in million meter) (bore 8mm to 10mm)	2
Radiator hoses (million nos.)	5
V-belts (million nos.)	2
Extruded components including rubber to metal components (ton)	3000

4. Cost of the project

	$ (million)
Land 6000 sq.m @ $20 per sq.	0.12
Building 2000 sq.m @ $800 per sq.m	1.60
Plant and machinery	5.00
Misc. expenses	0.70
	7.42

5. Personnel

Designation	Salary p.m $	No.	Amount ($)
Divisional manager	4,000	3	12,000
Engineer	3,000	10	30,000
Foreman	1,500	20	30,000
Technicians	1,500	20	30,000
Skilled workers	1,000	80	80,000
Unskilled workers	600	160	96,000
Total		293	278,000

Total per year ($3.55 million)

6. Turnover $ 23 million

7. Inputs	$ million
Raw materials	10.35
Consumables	1.15
Power 3000 KW	0.58
Salaries and wages	3.55
Misc. manufacturing expenses	0.69
Sales and services	0.46
Repairs and maintenance	0.30
Interest	1.65
Depreciation	0.60
Total	19.33

Net profit before tax (3.27 million)

1.16 Wiper Motors

1. Introduction

A wind screen wiper is a vital component for all vehicles to give the driver a clear vision during rains or dense fog. The wiper motor assembly consists of the mechanical linkages including the wiper arms with blades and a DC motor. Relatively the replacement demand for wiper motor is rather limited. On the contrary there is significant replacement for the wiper blades.

The major demand for wiper motor assembly comes from the manufacturers of equipment for OE fitment. Although the replacement demand for wiper motors is limited, as stated earlier, taking into account the large population of passenger cars, commercial vehicles in operation in ESCWA region the quantum of demand is large enough to establish indigenous capacity. The volume of production which is considered as 50,000 nos. wiper motors and 150,000 nos. wiper arms per year which is considered as minimum viable plant.

2. Production process

Most component parts of windshield wiper assemblies are produced by cold forming, on high performance transfer drawing and blanking-bending presses. This technology provides satisfactory efficiency and consistent quality. Windshield wipers consists of several components with more complex shape, these are produced by injection moulding, using high output, cold and hot chamber moulding machines and automatic plastic moulding machines.

Machining of the components is made on single or multispindle automatic lathes. For finishing parts, high precision grinding machines and smoothing-rolling machines are used. Heavy duty parts are protected against wear by various heat treatment processes such as carbonitriding, case hardening, high requency hardening. Windshield wiper component parts are electroplated to provide protection against corrosion. Wiper arm and blade parts are painted antireflection matt black.

Regarding the aspects of technology applied in the manufacture of the components, the percentage distribution as follows:

Cold forming	65%
Turning	13%
Injection moulding (plastic)	10%
Casting	3%
Miscellaneous	3%

Wiper motor rotors are assembled on assembly lines using special machines and equipment such as automatic rotor winding machine, commutator welder, semi-automatic, dynamic balancing and impregnating machine, special purpose machine for fine-turning and finishing commutators, etc. Parts between operations on the rotor-assembly-lines are handled and stored on conveyer lines.

3. Capacity

Wiper motors	50,000 nos. per year
Wiper arms	150,000 nos. per year

4. Cost of the project

	$
Land 3000 sq.m @ $20 per sq.	60,000
Building 800 sq.m @ $800 per sq.m	640,000
Plant and machinery	300,000
Misc. expenses	70,000
	1,070,000

5. Personnel

Designation	Salary p.m $	No.	Amount ($)
Divisional manager	4,000	1	4,000
Engineer	3,000	2	6,000
Foreman	1,500	6	9,000
Technicians	1,500	4	6,000
Skilled workers	1,000	20	20,000
Unskilled workers	600	36	21,000
Clericals	1,000	8	8,000
Total per year		86	74,000 per month

6. Turnover $ 2.0 million

7. Inputs	$ million
Raw materials and components	0.40
Consumables	1.14
Power 3000 KW	0.02
Salaries and wages	0.89
Repairs and maintenance	0.03
Misc. manufacturing expenses	0.02
Sales and services	0.02
Interest	0.20
Depreciation	0.80
Total	1.80

Profit before tax ($0.2 million)

2. Broad Profiles

2.1 Water Pump Assembly

The replacement market for water pump could be either in the form of complete pump or the water pump bearing by itself. It is reckoned that the replacement market would be about 5 per cent of the present population of all type of vehicles. This works out to over 300,000 nos. even on a very conservative side.

The economic parametes for the unit are given below:

Capacity	300,000 nos.
Sales turn over	$6 million
Project cost	$4 million
Employment	50

Manufacture of water pump assembly could be undertaken on the basis of a phased programme. During the first phase, the water pump bearing could be imported. As an when the demand picks up and product gains market acceptability manufacture of water pump bearings could also be established.

2.2 Bimetal Bearings

Bimetal bearings are also known as thinwalled bearings. They are used in internal combustion engines for assembly of connecting rods to crankshaft and crankshaft to the engine body. Bimetal bearings are usually made in two halves. Moreover Bimetal bushes in full circular form are also used in engines for specific purposes. Bimetal bearings are usually made in three different material compositions, namely, (1) steel backed - babbit material, (2) steel backed - copper alloyed material, and (3) steel backed - aluminium alloy material.

The more popular among these is steel backed - copper alloyed material. Whereas the steel backing provided structural strength, the copper alloy gives desired bearing properties. These are replacement items, normally required when overhauling the engine. The number of bearings differs from engine to engine depending on the number of cylinders. Four cylinder petrol driven engine normally has seven bearings - six sylinder diesel operated heavy vehicles have 13 bearings and 3 cylinders have seven bearings. The replacement cycle varies from 2 years for commercial vehicles and tractors to 4 years for passenger cars. Based on the above criterion and vehicle population, the replacement demand in 1990 works out to be in the region of several million sets.

The project parameters for an economic unit are given below:

Suggested capacity	5 to 6 million sets per year
Project cost	$ 10 million
Inputs	Ingot of copper, tin and lead
Employment	200 to 250

2.3 Radiators

Radiators are the main component of a cooling system of an internal combustion engine. It consists of water tank, copper tubes and copper fins. The water is force circulated through a water pump. Recently copper has been substituted by aluminium particularly for car application. However, bulk of the demand/production of the radiators all over the world continues to be copper based.

The major demand for radiators is for original equipment (OE) fitment. However, there is a limited demand to the extent of 1 per cent of the population of vehicles for the replacement market. Moreover the radiator is relatively a simple item to gain entry into OE market. Taking into consideration the replacement demand of 60,000 to 70,000 in 1990 reaching to 100,000 in 2000 and also the potential for OE market, a unit with an initial capacity of 100,000 nos. per year is presented.

The broad economics parameter are given below:

Annual capacity	100,000 nos.
Sales realisation	$ 10 million
Project cost	$ 3.5 million
Inputs	Copper strips, copper tubes and brass sheets.
Manpower	100

2.4 Under Carriage Components

Under carriage components refer to parts of crawler chains used on crawl mounted equipment such as loaders, dozers and crawler cranes. As the Under Carriage is subject to rugged usage on hard terrain. Hence the components wear out fast and require replacement. It has been the experience that the crawler chains have to be changed at least once in 3 years perhaps a little more frequently depending upon the terrain conditions on which crawler equipment are required to operate. The term Under Carriage components generally apply to track shoes, track pins, sprockets, idlers and rollers and other hardware items. There are firms specialising in the manufacture of these components to service the population of crawler mounted equipment.

The demand arising from the population of mounted equipment is alone large enough to establish more than one plant for providing Under Carriage components in different locations depending upon the concentration of the population of crawler mounted equipment. It is estimated that the annual demand would be at least 8000 to 10,000 sets of Undercarriage to serve the above population. The broad parameters for an economic unit are given below:

Annual capacity	3,000 sets
Sales value	$15 million

Each crawler chain will have linkages ranging from 58 to 78 depending upon the Horse Power of the equipment. The replacement would be either in the form of complete chain (both pairs) or would be in the form of individual link assembles.

Inputs Manganese alloy steel

The product has to withstand heavy duty applications, the technology involved is quite sophisticated.

2.5 Cutting Edges

Cutting edges and blades are used in bulldozers and scrapers and these require periodic replacement. It is estimated that the cutting edges/blades if manufactured to correct specifications have 500 hours operating life. There are 3 blades on a scrapers and 2 blades in dozers, each of approximately 12 inch in length. These blades have cutting edges on both sides and could be used twoice by reversing the blades. Taking into account the total population of 20,000 construction equipment consisting of scrapers and bulldozers there is a significant demand for these cutting blades. Even on a conservative estimate the demand works out to 150,000 per annum based on a 500 hours operating life. In fact some not give 500 hours of operating life, the effective demand would be even higher.

The economic parameters are as follows:

Capacity	100,000 sets
Sales turn over	$2.5 million
Project cost	$1.5 million
Employment	20
Input	Alloy steel

As the metallurgical characteristics of the blades and heat treatment have an important role in determining the life expectancy of the blades, it is desirable to have imported technology for producing these.

2.6 Plastic components

There are a number of plastic components such as tail lights, side lights, indicator lights which require replacement now and then. There are relatively simpler items from the point of view of manufacturing technology. What is however more important is the design of the various moulds and dies which determine reflection quality to be taken care of is in regard to the specification of the raw materials. With an estimated populat on of 6 million cars in 1990 going to 8 million in 2000 coupled with a population of over 1.4 light commercial vehicles in 1990 there would be good

scope for the establishment of a number of medium scale units in different areas manufacturing these plastic components.

Capacity	50,000 nos.
Sales turn over	$1 million
Project cost	$1 million
Employment	10

3. Project Ideas

3.1 Leaf springs, coil springs, stabilizers, U-belts for leaf springs, stud bolts, king pins, shakle pins.

Medium and low complexity design. Medium and low complexity technology. Minimum viable capacity 10,000-20,000, capital investment, equipment only 2-3 US$ million.

Manpower:

Managers, Administration	2-10
Skilled/semi-skilled	20-100

3.2 Filter elements, air cleaners.

Medium and low complexity design, medium and low complexity technology minimum viable capacity 10,000-12,000, capital investment; equipment only 5-10 US$ million.

Manpower:

Managers, Administration	2-10
Skilled/semi-skilled	20-30

3.3 Mechanical cables: (speeddometer cables, accelerator cables, clutch releases).

Low complexity design, low complexity technology, min. viable capacity, 20,000-50,000, capital investment; equipment only 2-5 US$ million.

Manpower:

Managers, Administrators	2-5
Skilled/semi-skilled	20-60

3.4 Wheel rims, wheel discs, bumpers, mufflers.

Low complexity design, low complexity technology, min. viable capacity 10,000-20,000, capital investment. 1-2 US$ million (equipment).

Manpower:

Managers, Administrators	2-10
Skilled/semi-skilled	20-100

3.5 Fuses, switches, fuse boxes, horns, sockets, light fittings.

Medium complexity design, medium complexity technology, min. viable capacity, 20,000-30,000, capital investment 3-4 US$ million.

Manpower:

Managers, Administrators	10-15
Skilled/semi-skilled	50-100

3.6 Seats (bus, truck, tractor, construction equipment).

Low complexity design, low complexity technology, min. viable capacity 5,000-10,000, capital investment. 0.5 US$ million (equipment).

Manpower:

Managers, Administrators	2-3
Skilled/semi-skilled	20-30

3.7 Castings (iron, steel, non-ferrous metals, forgings, hot stampings).

Medium and low complexity design, medium and low complexity technology, min. viable capacity, 500-1000 ton, capital investment 5-10 US$ million.

Manpower:

Managers, Administrators	10-20
Skilled/semi-skilled	150-200

3.8 Stampings (cold stampings):

Medium and low complexity design, medium and low complexity technology, min. viable capacity, 1000-2000 ton, capital investment 1-2 US$ million.

Manpower:

Managers, Administrators	5-10
Skilled/semi-skilled	50-60

3.9 Heavy and medium boiler making services (construction equipment ACC) plating to 1 1/4 inch.

Medium and low complexity design, medium and low complexity technology, min. viable capacity, 1000-5000 ton, capital investment 1-2 US$ million.

Manpower:

Managers, Administrators	5-10
Skilled/semi-skilled	50-100

3.10 Tools, metal moulds, dies, shell moulds, jigs fixtures, templates.

High and medium complex, design light and medium complex technology, min. viable capacity, 2-3 US$ million, capital investment; equipment.

Manpower:

Managers, Engineers, Adm.	10-20
Skilled/semi-skilled	100-200

3.11 Heat treatment, metallic coatings, scouring etc.

High complexity design, high complexity technology, min. viable capacity, 5000-10,000 ton, capital investment 10-20 US$ million.

Manpower:

Managers, Engineers, Adm.	10-15
Skilled/semi-skilled	100-150

Table (I - 1)

Distribution of turnover of principal manufacturers by sector activity - 1979

Massey ferguson	
- Agricultural equipment	93.4%
- Industrial equipment	6.6%
International harvester	
- Trucks	47.3%
- Agricultural equipment	36.6%
- Industrial & construction equipment	11.9%
- Others	4.2%
Ford	
- Auto	91.7%
- Agricultural equipment	4.8%
- Trucks & others	3.5%
John Deerc	
- Agricultural equipment	79.8%
- Industrial equipment	20.2%
Fiat	
- Autombiles	45.0%
- Tractors	6.0%
- Industrial vehicles & public transport	24.6%
- Civil engineering	7.8%
- Others	16.6%
Renault	
- Automobiles	70.4%
- Transportation and others	11.0%
- Agricultural equipment	3.4%
- Others	15.2%
Kubota	
- Agricultural equipment	39.3%
- Others	60.7%

Source: The Agricultural Machinery Industry in the 1980s factors for International Co-operation, second consultation on the Agricultural Machinery Industry, Buenos Aires 17-22/10/83 by Pascal Bye & Jean Jacques Chanaron.

Table (I - 2)

Tractors
Principal producers'shares of world market-1980

Producers	No.	% of total
Massey-Fergyson	120,000	15.0
John Deere	95,000	11.5
International Harvester	88,000	10.7
Ford	80,000	9.7
Fiat	55,000	6.7
Same	30,000	3.6
David Brown/Case	28,000	3.4
Deutze	25,000	3.0
Volvo Valmet	18,000	2.2
Renault	13,000	1.6
Fendt	12,000	1.4
Other	256,000	31.0
Total	820,000	100

Source: The agricultural machinery industry in the 1980s-Factors for international co-operation, prepared by Pascal Bye and Jean Jacques Chanaron-Second Consultation on the Agricultural Machinery Industry. Buenos Aires, 17-22 October 1983 - UNIDO, ID/WG400/1.

Table (I - 3)

Production of commercial vehicles by selected countries
Units

Countries	1977	1980	1981
Western Europe			
France	415,442	439,852	407,506
Germany, Fed.Rep. of	313,672	357,619	319,200
Italy	144,076	165,066	176,403
Netherlands	13,093	15,656	12,223
Spain	140,736	152,846	132,149
Sweden	51,518	63,080	55,494
Australia	n.a	47,143	40,044
Austria	n.a	8,533	7,923
Belgum	n.a	39,525	41,401
U.K	386,420	389,170	229,555
Yugoslavia	26,645	28,516	26,869
			1,448,767

Eastern Europe			
Czeckoslovakia	38,598	45,688	45,908
German Dem. Rep.	37,236	36,954	39,396
Hungary	13,409	12,406	11,101
Poland	90,284	66,475	48,700
Romania	53,897	40,232	19,483
USSR	808,600	872,300	873,900
			1,038,488
North America			
Canada	571,192	524,324	496,822
United States	3,482,330	1,635,122	1,680,007
			2,176,829
Central and South America			
Argentina	n.a	63,153	32,922
Brazil	147,633	564,501	373,832
Mexico	n.a	186,950	241,621
			648,375
Asia			
Japan	3,083,477	4,004,776	4,205,831
India	n.a	83,379	106,781
Korea	n.a	65,910	64,324
Total			4,376,936
Grand total			9,689,395

Source: Transnational corporations in the International Auto Industry, UN Centre on Transnational Corporations, N.Y,1982.

Table (I - 4)

World wide registration of trucks and buses

	as of 1/1/1979	as of 1/1/1980
North America	34,641,000	36,727,000
Western Europe	10,881,306	11,418,355
Eastern Europe	9,124,211	9,718,740
Africa	2,821,115	2,905,961
Middle East	2,146,375	2,419,367
Far East	16,233,349	17,394,119
Pacific	1,713,615	1,770,690
Caribbean	335,177	347,153
Central & South America	5,987,073	6,648,331
Total	83,883,221	89,349,716

Source: Transnational corporations in the international Auto Industry, UN Centre on Transnational Corporations, N.Y.,1982.

Table III-1
Total population of tractors (nos.) - ESCWA Region
Agricultural sector

Country	1980
Bahrain	80
Egypt	25,000
Iraq	32,000
Jordan	2,320(1)
Kuwait	50
Lebanon	4,000(2)
Oman	100
Qatar	100
Saudi Arabia	9,650
Syria	28,000
UAE	60
YAR	2,000
PDRY	1,500
	104,860

(1) Population as of 1.3.1983

(2) Population as of 1977

Source: Compiled from several sources and field missions.

Table III-2
GNP/Capita and Area per tractor
in selected countries

Country	GNP/Capita ($US)	Hectares/Tractor
Austria	5000	13
Netherlands	5900	13
W. Germany	6900	12
Belgium	6350	14
France	6400	16
Denmark	7000	16
UK	4100	17
Italy	2800	17
Japan	4500	18
USA	7500	60
Canada	7000	68
Jordan	400	100
Turkey	900	120

source: Joint ESCWA/UNIDO Industry Division.

Table III-3
Tractors (nos.)
Yearly Demand - Egypt

Year	Population	Demand
1980	25,000	
1981	25,910	3844
1982	26,558	3940
1983	27,222	4040
1984	27,902	4139
1985	28,600	4244
1986	29,321	4356
1987	30,048	4459
1988	30,799	4570
1989	31,570	4685
1990	32,358	4800
1991	33,167	4921
1992	33,997	5045
1993	34,847	5171
1994	35,717	5299
1995	36,610	5432
1996	37,525	5567
1997	38,463	5697
1998	39,425	5850
1999	40,411	5996
2000	41,421	6146

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-4

Tractors (nos.)

Yearly Demand - Iraq

Year	Population	Demand
1980	32,000	
1981	33,800	5484
1982	34,899	5663
1983	36,032	5845
1984	37,203	6036
1985	38,412	6232
1986	39,660	6434
1987	40,949	6643
1988	42,280	6859
1989	43,655	7083
1990	45,074	7313
1991	45,539	7550
1992	48,051	7795
1993	49,613	8049
1994	51,225	8310
1995	52,890	8581
1996	54,600	8861
1997	56,383	9146
1998	582167	9445
1999	60,108	9752
2000	62,062	10069

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-5

Tractors (nos.)

Yearly Demand - Jordan

Year	Population	Demand
1980	-	-
1981	-	-
1982	2320	-
1983	2460	385
1984	2578	405
1985	2699	422
1986	2828	444
1987	2962	464
1988	3103	486
1989	3250	509
1990	3405	534
1991	3567	559
1992	3736	585
1993	3913	613
1994	4099	643
1995	4294	673
1996	4499	705
1997	4712	738
1998	4936	774
1999	5169	809
2000	5416	850

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-6

Tractors (nos.)

Yearly Demand - Lebanon

Year	Population	Demand
1980	4000	-
1981	4102	562
1982	4185	581
1983	4268	592
1984	4354	604
1985	4440	615
1986	4530	629
1987	4620	641
1988	4713	654
1989	4806	666
1990	4903	681
1991	5000	693
1992	5100	707
1993	5202	721
1994	5305	735
1995	5412	751
1996	5521	766
1997	5632	782
1998	5744	797
1990	5827	813
2000	5977	830

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-7

Tractors (nos.)

Yearly Demand - Saudi Arabia

Year	Population	Demand
1980	10,000	-
4981	10,444	1559
1982	10,723	1609
1983	11,134	1662
1984	11,496	1716
1985	11,869	1771
1986	12,254	1828
1987	12,654	1889
1988	13,064	1948
1989	13,488	2011
1990	13,927	2078
1991	14,379	2144
1992	14,847	2215
1993	15,329	2287
1994	15,828	2362
1995	16,343	2439
1996	16,874	2518
1997	17,422	2594
1998	17,989	2684
1999	18,573	2771
2000	19,176	2860

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-8
Tractors (nos.)
Yearly Demand - Syria

Year	Population	Demand
1980	28,000	-
1981	29,867	4827
1982	31,286	5056
1983	32,773	5297
1984	34,329	5547
1985	35,959	5811
1986	37,667	6087
1987	39,457	6377
1988	41,331	6679
1989	43,294	6996
1990	45,351	7329
1991	47,505	7677
1992	49,761	8041
1993	52,131	8429
1994	54,600	8823
1995	57,194	9243
1996	59,911	9682
1997	62,757	10142
1998	65,738	10623
1999	68,850	11127
2000	72,131	11657

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-9
Tractors (nos)
Yearly Demand - ESCWA Region

Country	1985	1990	1995	2000
Bahrain	12	14	15	17
Egypt	4244	4800	5432	6146
Iraq	6232	7313	8581	10069
Jordan	422	534	673	850
Kuwait	10	12	15	17
Lebanon	615	681	751	830
Oman	16	20	22	25
Qatar	16	20	22	25
Saudi Arabia	1771	2078	2439	2860
Syria	5811	7329	9243	11657
UAE	10	12	15	20
YAR	200	250	290	320
PDRY	150	190	220	250
	19,509	23,253	27,718	33,086

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-10
Tractors (nos.)
Population - ESCWA Region

Country	1985	1990	1995	2000
Bahrain	90	102	115	130
Egypt	28,600	32,358	36,610	41,421
Iraq	38,412	45,074	52,890	62,062
Jordan	2,699	3,405	4,294	5,416
Kuwait	57	64	72	82
Lebanon	4,440	4,903	5,412	5,977
Oman	113	128	145	164
Qatar	113	128	145	164
Saudi Arabia	11,869	13,927	16,343	19,176
Syria	35,959	45,351	57,194	72,131
UAE	73	89	108	131
YAR	2,260	2,560	2,900	3,280
PDRY	1,697	1,920	2,172	2,458
	126,382	150,009	178,400	212,592

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-11
Trucks and Vans in use (nos)
ESCWA Region

Country	1973	1974	1975	1976	1977	1978	1979	1980
Bahrain	5156	6343	8382	11109	11618	11693	12629	16604
Egypt	48000	40000	46000	57000	64000	85000	114731(1)	
Iraq	46074	51596	67425	62044	54528	64482	129404(1)	
Jordan	5414	6087	8878	12493	17419	10015	29994(1)	
Kuwait	41368	46706	64688	79267	95247	111285	125450	135601
Lebanon	19151	20983	22367	22350	25188	30252*	32194	
Oman	7247*	9925*	15108*	20360*	25707*	30936*	40000(1)	
Qatar	-	-	13004	17901	22993	25671	28293	32367
S.Arabia	118451*	168730*	253077*	389648*	535648*	613630*	772862(1)	
Syria	13248	13622	19184	23471	31522	25614	64053(1)	
UAE	10345	15210	19597	27591	37013	41406	77065(1)	
YAR	5452*	6107*	6840*	6977*	7814*	8538*	32370(1)	
PDRY	6912	7036	8523	9137	9560	11182	15199(1)	

* Estimated, ESCWA.

(1) Includes Buses - World Automotive Market - 1981 Edition.

Source: Statistical Abstract of the Region
Economic Commission for Western Asia, 1970-1979

Table III-12
Buses in use (nos)
ESCWA region

Country	1973	1974	1975	1976	1977	1978	1979	1980
Bahrain	729	873	1051	1266	1588	1759	1907	1825
Egypt(1)	-	-	-	-	-	-	-	-
Iraq	14318	16200	19594	20650*	19989	21590	26782*	29460*
Jordan	502	529	706	713	795	981	1170	1362
Kuwait	2814	2888	3836	5080	6489	7230	7854	8425
Lebanon	2258	2397	2480	2457	2529	3050*	2674	3449
Oman(1)	-	-	-	-	-	-	-	-
Qatar	492*	605*	684	935	1165	1341	1589	2017
Saudi Arabia	5703*	8065*	9504*	12612*	15434*	18888*	22517*	27032*
Syria	2525	2826	4192	5631	6829	7178	7420	8135*
UAE	479*	709*	875*	1134*	1457*	1630*	1823*	2039*
YAR(1)	-	-	-	-	-	-	-	-
PDRY	194	213	229	402	504	586	708	-

* Estimated, ESCWA.

(1) Included with Trucks.

Source: compiled from several sources.

Table III-13
Population of Trucks of 3.5T GVW and above
Population Buses of 20-60 seats
for 1979 (nos)

Country	Trucks	Buses
Bahrain	8,840	1,525
Egypt	72,280	9,178
Iraq	71,835	21,426
Jordan	20,177	936
Kuwait	87,815	6,283
Lebanon	22,536	2,139
Oman	26,320	1,920
Qatar	19,805	1,271
Saudi Arabia	525,242	18,014
Syria	39,643	5,936
UAE	52,669	1,458
YAR	21,299	1,554
PDRY	10,144	566
	978,605	72,206

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-14
Population, GNP/Capita, Number of CV and buses per 1000 inhabitants in selected countries
1980

Country	Population in (million)	GNP(1) Per capita US $	Population trucks and buses 000	Trucks, buses per 1000 inhabitants
France	53.5	11,730	2,550	48
W. Germany	61.3	13,590	1,548	25
Greece	9.4	4,380	367	39
Italy	56.9	6,480	1,436	25
Netherlands	14.1	11,470	380	27
Portugal	9.8	2,370	306	31
Spain	37.1	5,400	1303	35
UK	55.9	7,920	1933	35
Bulgaria	8.8	4,150	130	15
E. Germany	16.8	7,180	645	38
USSR	262.4	4,550	7,254	28
Yugoslavia	22.2	2,620	317	14
Brazil	119.7	2,050	2,012	17
Mexico	65.7	2,090	1,487	23
USA	222.1	11,360	33,927	153
Turkey	44.6	1,470	401	9
Iran	37.4	-	396	11
Indonesia	148.1	430	453	3
Canada	23.7	10,130	2,800	118

Source: Transnational Corporations in the International Auto-Industry, UN, Centre on Transnational Corporation. N.Y,1982.

Table III-15
Average Annual growth rate
GNP per capita

ESCWA region

Country	1960-1970	1970-1977	1960-1980
Bahrain	2.8	0.2(1)	-
Egypt	1.7	5.2	3.4
Iraq	2.5	7.1	5.3
Jordan	2.9	6.5(2)	5.7
Kuwait	13.5	-0.9	-1.1
Lebanon	0.5	-	-
Oman	17.1	4.0	-
Qatar	0.5	-2.4	-
Saudi Arabia	8.0	13.0	8.1
Syria	3.4	6.1	3.7
UAE	18.5	-3.6	4.3
YAR	2.0	-	4.5
PDRY	-	-	12.1

Source: World Bank Atlas and World Development Report 1982, World Bank

(1) Growth rate relates to 73-77

(2) Growth rate relates to 72-77

Table III-16
Population, GNP per capita and number of CV and buses per 1000 inhabitants, ESCWA region - 1980

Country	Population in (million)	GNP(1) Per capita US $	Population trucks and buses 000	Trucks, buses per 1000 inhabitants
Bahrain	0.37	-	16.9	46
Egypt	40.9	580	114.7	3
Iraq	12.9	3,020	129.4	10
Jordan	3.2	1,420	29.9	9
Kuwait	1.28	19,830	133.3	104
Lebanon	2.94	-	34.9	12
Oman	.864	-	40.0	46
Qatar	.21		24.7	118
Saudi Arabia	9.29	11,260	772.9	83
Syria	8.5	1,340	64.1	8
UAE	.87	26,850	77.1	89
YAR	5.1	430	32.4	6
PDRY	1.86	420	15.2	8

Source: Automobile International World Automobile Market - 1981.

(1) World Development Report, World Bank - 1982.

Table III-17
CV (nos.)
Yearly Demand - Bahrain

Year	Population	Demand
1979	8,840	
1980	9,105	1259
1981	9,378	1297
1982	9,660	1336
1983	9,950	1376
1984	10,248	1417
1985	10,555	1459
1986	10,872	1504
1987	11,198	1549
1988	11,534	1595
1989	11,880	1645
1990	12,237	1692
1991	12,604	1743
1992	12,982	1795
1993	13,371	1848
1994	13,772	1904
1995	14,186	1962
1996	14,611	2019
1997	15,049	2080
1998	15,500	2143
1999	15,966	2209
2000	16,445	2274

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-18
CV (nos)
Yearly Demand - Egypt

Year	Population	Demand
1979	72,280	-
1980	74,810	10481
1981	77,428	10847
1982	80,138	11227
1983	82,943	11620
1984	85,846	12027
1985	88,851	12448
1986	91,960	12883
1987	95,179	13335
1988	98,510	13801
1989	101,958	14284
1990	105,527	14784
1991	109,220	15301
1992	113,043	15837
1993	116,999	16391
1994	121,094	16965
1995	125,332	17558
1996	129,719	18173
1997	134,259	18809
1998	138,958	19468
1999	143,822	20149
2000	148,856	20854

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-19
CV (nos)
Yearly Demand - Iraq

Year	Population	Demand
1979	71,835	-
1980	75,427	11120
1981	79,198	11676
1982	83,158	12260
1983	87,316	12873
1984	91,682	13517
1985	96,266	14192
1986	101,079	14801
1987	106,133	15647
1988	111,440	16430
1989	117,012	17251
1990	122,862	18113
1991	129,005	19019
1992	135,456	19971
1993	142,228	20968
1994	149,340	22018
1995	156,807	23118
1996	164,647	24273
1997	172,879	25487
1998	181,523	26762
1999	190,599	28100
2000	200,129	29505

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-20
CV (nos.)
Yearly Demand - Jordan

Year	Population	Demand
1979	20,177	-
1980	21,287	3186
1981	22,458	3361
1982	23,693	3546
1983	24,996	3741
1984	26,371	3947
1985	27,821	4164
1986	29,351	4393
1987	30,965	4634
1988	32,668	4889
1989	34,465	5159
1990	36,361	5442
1991	38,361	5742
1992	40,470	6056
1993	42,696	6390
1994	45,045	6742
1995	47,522	7112
1996	50,136	7504
1997	52,893	7916
1998	55,802	8352
1999	58,872	8812
2000	62,110	9296

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-21
C.V (nos.)
Yearly Demand - Kuwait

Year	Population	Demand
1979	87,815	-
1980	90,449	12510
1981	93,163	12887
1982	95,958	13373
1983	98,836	13660
1984	101,802	14082
1985	104,856	14504
1986	108,001	14938
1987	111,241	15388
1988	114,579	15849
1989	118,016	16324
1990	121,556	16813
1991	125,203	17318
1992	128,959	17838
1993	132,828	18373
1994	136,813	18924
1995	140,917	19491
1996	145,145	20077
1997	149,500	20679
1998	153,984	21298
1999	158,604	21939
2000	163,362	22596

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-22
C.V (nos.)
Yearly Demand - Lebanon

Year	Population	Demand
1979	22,536	-
1980	23,325	3268
1981	24,141	3382
1982	24,986	3501
1983	25,861	3623
1984	26,766	3750
1985	27,702	3880
1986	28,672	4017
1987	29,676	4158
1988	30,714	4322
1989	31,789	4454
1990	32,902	4620
1991	34,053	4760
1992	35,245	4938
1993	36,479	5111
1994	37,756	5290
1995	39,077	5474
1996	40,445	5666
1997	41,860	5864
1998	43,325	6070
1999	44,842	6283
2000	46,411	6502

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-23
C.V (nos.)
Yearly Demand - Oman

Year	Population	Demand
1979	26,320	-
1980	27,110	3750
1981	27,923	3862
1982	28,761	3978
1983	29,623	4097
1984	30,512	4221
1985	31,427	4347
1986	32,370	4478
1987	33,341	4612
1988	34,342	4751
1989	35,372	4892
1990	36,433	5039
1991	37,526	5191
1992	38,652	5347
1993	39,811	5506
1994	41,006	5671
1995	42,236	5842
1996	43,503	6017
1997	44,808	6198
1998	46,152	6384
1999	47,537	6576
2000	48,963	6872

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-24
CV (nos.)
Yearly Demand - Qatar

Year	Population	Demand
1979	19,805	
1980	20,399	2821
1981	21,011	2906
1982	21,641	2993
1983	22,291	3084
1984	22,959	3175
1985	23,648	3271
1986	24,358	3370
1987	25,088	3470
1988	25,841	3575
1989	26,616	3681
1990	27,415	3793
1991	28,237	3905
1992	29,084	4023
1993	29,957	4144
1994	30,855	4267
1995	31,781	4396
1996	32,734	4527
1997	33,716	4564
1998	34,728	4804
1999	35,770	4948
2000	36,843	5096

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-25
C.V (nos.)
Yearly Demand - Saudi Arabia

Year	Population	Demand
1979	525,242	-
1980	540,999	74,831
1981	557,229	77,076
1982	573,946	79,389
1983	591,164	81,770
1984	608,899	84,223
1985	627,166	86,750
1986	645,981	89,352
1987	665,361	92,034
1988	685,322	94,794
1989	705,881	97,637
1990	727,058	100,567
1991	748,869	103,583
1992	771,335	106,691
1993	794,476	109,893
1994	818,310	113,189
1995	842,859	116,584
1996	868,145	120,082
1997	894,189	123,684
1998	921,015	127,395
1999	948,645	131,217
2000	977,105	135,154

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-26
C.V. (nos.)

Yearly Demand - Syria

Year	Population	Demand
1979	39,643	
1980	41,229	5,887
1981	42,878	6,122
1982	44,593	6,367
1983	46,377	6,622
1984	48,232	6,887
1985	50,161	7,162
1986	52,167	7,448
1987	54,254	7,747
1988	56,424	8,057
1989	58,681	8,379
1990	61,029	8,715
1991	63,470	9,063
1992	66,009	9,425
1993	68,649	9,802
1994	71,395	9,194
1995	74,251	10,602
1996	77,221	11,026
1997	80,309	11,466
1998	83,522	11,927
1999	86,863	12,403
2000	90,337	12,899

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-27
C.V. (nos.)

Yearly Demand - UAE

Year	Population	Demand
1979	52,669	-
1980	54,249	7,504
1981	55,877	7,729
1982	57,553	7,960
1983	59,279	8,199
1984	61,058	8,446
1985	62,890	8,699
1986	64,776	8,959
1987	66,719	9,228
1988	68,721	9,506
1989	70,783	9,791
1990	72,906	10,084
1991	75,093	10,386
1992	77,346	10,699
1993	79,666	11,019
1994	82,057	11,351
1995	84,518	11,690
1996	87,054	12,042
1997	89,665	12,402
1998	92,355	12,775
1999	95,126	13,158
2000	97,980	13,573

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-28
C.V. (nos.)

Yearly Demand - YAR

Year	Population	Demand
1979	26,299	
1980	22,044	3,088
1981	22,816	3,197
1982	23,615	3,309
1983	24,441	3,424
1984	25,297	3,545
1985	26,182	3,668
1986	27,098	3,796
1987	28,047	3,930
1988	29,028	4,066
1989	30,044	4,209
1990	31,096	4,357
1991	32,184	4,509
1992	33,310	4,666
1993	34,476	4,831
1994	35,683	5,000
1995	36,932	5,175
1996	38,225	5,356
1997	39,563	5,543
1998	40,947	5,736
1999	42,381	5,939
2000	43,864	6,145

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-29
C.V. (nos.)

Yearly Demand - PDRY

Year	Population	Demand
1979	10,144	-
1980	10,499	1,471
1981	10,867	1,523
1982	11,247	1,575
1983	11,640	1,630
1984	12,048	1,688
1985	12,470	1,747
1986	12,906	1,808
1987	13,358	1,872
1988	13,825	1,936
1989	14,309	2,004
1990	14,810	2,075
1991	15,328	2,147
1992	15,865	2,223
1993	16,420	2,300
1994	16,995	2,381
1995	17,590	2,464
1996	18,205	2,549
1997	18,842	2,639
1998	19,502	2,732
1999	20,184	2,827
2000	20,891	2,927

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-30
C.V. 3.5T GVW and above (nos.)

Population - ESCWA Region

Country	1985	1990	1995	2000
Bahrain	10,555	12,237	14,186	16,455
Egypt	88,851	105,527	125,332	148,856
Iraq	96,266	122,862	156,807	200,129
Jordan	27,821	36,361	47,522	62,110
Kuwait	104,856	121,556	140,917	163,362
Lebanon	27,702	32,902	39,077	46,411
Oman	31,427	36,433	42,236	48,963
Qatar	23,648	27,415	31,781	36,843
Saudi Arabia	627,166	727,058	842,859	977,105
Syria	50,161	61,029	74,251	90,337
UAE	62,890	72,906	84,518	97,980
YAR	26,182	31,096	36,932	43,864
PDRY	12,470	14,810	17,590	20,891
	1,240,156	1,402,192	1,654,008	1,953,296

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-31
C.V. (nos.)

Yearly Demand - ESCWA Region

Country	1985	1990	1995	2000
Bahrain	1,459	1,692	1,962	2,274
Egypt	12,448	14,784	17,558	20,854
Iraq	14,192	18,113	23,118	29,505
Jordan	4,164	5,442	7,112	9,296
Kuwait	14,504	16,813	19,491	22,596
Lebanon	3,880	4,620	5,474	6,502
Oman	4,347	5,039	5,842	6,872
Qatar	3,271	3,793	4,396	5,096
Saudi Arabia	86,750	100,567	116,584	135,154
Syria	7,162	8,715	10,602	12,899
UAE	8,699	10,084	11,690	13,573
YAR	3,668	4,357	5,175	6,145
PDRY	1,747	2,075	2,464	2,927
	166,291	196,094	231,468	273,693

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-32
C.V. (nos.)

Yearly Demand - ESCWA Region
According to Engine Power

Engine Power	1985	1990	1995	2000
70 hp (35 per cent)	58,202	68,633	81,014	95,793
140 hp (30 per cent)	49,887	58,828	69,440	82,108
200 hp (20 per cent)	33,258	39,218	46,292	54,738
300 hp (15 per cent)	24,944	29,415	34,722	41,054
	166,291	196,094	231,468	273,693

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-33
Buses, 20-60 seats (nos.)

Population, Yearly Demand - ESCWA Region

Year	Population	Demand
1979	72,206	-
1980	74,733	10,460
1981	77,349	10,836
1982	80,056	11,215
1983	82,858	11,608
1984	85,758	12,014
1985	88,760	12,434
1986	91,866	12,870
1987	95,082	13,320
1988	98,409	13,787
1989	101,854	14,269
1990	105,419	14,769
1991	109,108	15,285
1992	112,927	15,820
1993	116,879	16,374
1994	120,970	16,947
1995	125,204	17,541
1996	129,586	18,154
1997	134,122	18,789
1998	138,816	19,447
1999	143,675	20,138
2000	148,703	20,832

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-34
Construction Equipment (nos.)

Sales and Population - 1975-1976 - ESCWA Region

Type of Equipment	Sales 1975	Sales 1976	Population end 1975	Population end 1976
Hydraulic excavators	539	413	2,825	2,035
Backhoe/loaders	353	365	792	815
Wheel loaders	2,540	2,340	9,445	11,050
Cramler loaders	706	545	3,138	2,940
Cramler dozers	2,638	1,945	11,785	12,550
Motor scraper	369	302	1,606	1,225
Motor graders	1,202	1,015	5,525	5,905
Road making plant	247	287	1,168	1,216
Compaction plant, vibrated	917	986	2,615	3,210
Compaction plant, deadweight	650	609	2,690	2,980
Truck cranes	454	460	2,855	3,020
Cranes telescopic	849	1,041	1,964	2,640
Cramler cranes	549	474	3,724	3,675
Tower cranes	372	536	1,023	1,430
	12,385	11,318	51,155	54,691

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-35
Construction Equipment

Sales and Population 1975-1976 - ESCWA Region

Country	Sales 1975	Sales 1976	Population 1975	Population 1976
Bahrain	308	-	1,141	-
Egypt	1,714	1,323	9,130	7,560
Iraq	3,485	2,520	15,680	15,590
Jordan (1)	-	-	-	-
Kuwait	454	-	1,711	-
Lebanon	n.a.	n.a.	n.a.	n.a.
Oman	290	-	1,523	-
Qatar	332	-	1,123	-
Saudi Arabia	4,100	4,438	13,790	16,845
Syria	937	979	4,345	5,100
UAE	765	-	2,712	-
YAR(2)	-	-	-	-
PDRY	n.a.	n.a.	n.a.	n.a.
Total	12,385	11,318(3)	51,155	54,691(4)

Source: Joint ESCWA/UNIDO Industry Division Estimate.

(1) Included with Syria.
(2) Included with Saudi Araba.
(3) Total sales in 1976 for Bahrain, Kuwait, Oman, Qatar and UAE amounted to 2,658.
(4) Population end 1976 for Bahrain, Kuwait, Oman. Qatar and UAE amounted to 9,596.

Table III-36
Hydraulic Excavators (nos.)

Country	Annual Demand 1980	1985	1990	1995	2000
Bahrain	4	5	6	7	8
Egypt	17	20	23	27	32
Iraq	275	322	376	440	515
Jordan	4	5	6	7	8
Kuwait	12	14	17	19	22
Lebanon	-	-	-	-	-
Oman	4	5	6	7	8
Qatar	7	8	10	11	13
Saudi Arabia	185	216	253	296	347
Syria	9	11	12	14	17
UAE	20	23	27	32	37
YAR	-	-	-	-	-
PDRY	-	-	-	-	-
	537	629	736	860	1,007

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-37
Loaders (1) (nos.)

Annual Demand

Country	1980	1985	1990	1995	2000
Bahrain	49	57	67	78	92
Egypt	202	236	277	324	379
Iraq	1,181	1,382	1,617	1,892	2,213
Jordan	60	70	82	96	112
Kuwait	146	171	200	234	274
Lebanon	-	-	-	-	-
Oman	55	64	75	88	103
Qatar	94	110	129	151	176
Saudi Arabia	1,849	2,163	2,531	2,961	3,465
Syria	139	163	190	223	260
UAE	254	297	348	407	476
YAR	-	-	-	-	-
PDRY	-	-	-	-	-
	4,029	4,713	5,516	6,454	7,750

Source: Joint ESCWA/UNIDO Industry Division Estimate.

(1) Covers, backhoe loaders, rubber tyre and crawler loaders.

Table III-38
Crawler Dozers (nos.)

Annual Demand

Country	1980	1985	1990	1995	2000
Bahrain	33	39	45	53	62
Egypt	169	198	231	271	317
Iraq	787	921	1,077	1,260	1,475
Jordan	46	54	63	74	86
Kuwait	98	115	134	157	184
Lebanon	-	-	-	-	-
Oman	37	43	51	59	69
Qatar	62	73	85	99	116
Saudi Arabia	1,849	2,163	2,531	2,961	3,465
Syria	109	128	149	175	204
UAE	169	198	231	271	316
YAR	-	-	-	-	-
PDRY	-	-	-	-	-
	3,359	3,932	4,597	5,380	6,294

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-39
Motor Scrapers (nos.)

Country	Annual Demand 1980	1985	1990	1995	2000
Bahrain	3	4	4	5	6
Egypt	34	40	47	54	64
Iraq	79	92	108	127	148
Jordan	4	4	4	5	6
Kuwait	10	12	14	16	19
Lebanon	-	-	-	-	-
Oman	4	4	4	5	6
Qatar	6	7	8	10	11
Saudi Arabia	203	238	278	325	357
Syria	10	12	14	16	19
UAE	17	20	23	27	32
YAR	-	-	-	-	-
PDRY	-	-	-	-	-
	370	433	504	590	668

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-40
Motor Graders (nos.)

Country	Annual Demand 1980	1985	1990	1995	2000
Bahrain	13	15	18	21	24
Egypt	76	89	104	122	142
Iraq	394	461	539	631	738
Jordan	19	22	26	30	36
Kuwait	39	46	53	62	73
Lebanon	-	-	-	-	-
Oman	15	18	21	24	28
Qatar	25	29	34	40	47
Saudi Arabia	832	973	1,139	1,333	1,559
Syria	44	51	60	71	82
UAE	68	80	93	109	127
YAR	-	-	-	-	-
PDRY	-	-	-	-	-
	1,525	1,784	2,087	2,443	2,856

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-41
Road Making Plants (nos.)

Annual Demand

Country	1980	1985	1990	1995	2000
Bahrain	3	4	4	5	6
Egypt	25	29	34	40	47
Iraq	55	64	75	88	103
Jordan	3	4	4	5	6
Kuwait	10	12	14	16	19
Lebanon	-	-	-	-	-
Oman	4	5	6	6	8
Qatar	6	7	8	10	11
Saudi Arabia	222	260	304	356	416
Syria	7	8	10	11	13
UAE	17	20	23	27	32
YAR	-	-	-	-	-
PDRY	-	-	-	-	-
	352	413	482	564	661

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-42
Compaction Plants (1) (nos.)

Annual Demand

Country	1980	1985	1990	1995	2000
Bahrain	29	34	40	46	54
Egypt	69	81	94	111	129
Iraq	236	276	323	378	442
Jordan	23	27	32	37	43
Kuwait	88	103	120	141	165
Lebanon	-	-	-	-	-
Oman	33	39	45	53	62
Qatar	56	66	77	90	105
Saudi Arabia	925	1,082	1,260	1,481	1,733
Syria	55	64	75	88	103
UAE	152	178	208	243	285
YAR	-	-	-	-	-
PDRY	-	-	-	-	-
	1,666	1,950	2,280	2,668	3,121

Source: Joint ESCWA/UNIDO Industry Division Estimate.

(1) covers both vibrated weight type.

Table III-43
Cranes (1) (nos.)

Annual Demand

Country	1980	1985	1990	1995	2000
Bahrain	43	50	59	69	81
Egypt	202	236	277	324	379
Iraq	787	921	1,077	1,260	1,475
Jordan	23	27	32	37	43
Kuwait	127	149	174	203	238
Lebanon	-	-	-	-	-
Oman	46	54	63	74	86
Qatar	82	96	112	131	154
Saudi Arabia	1,108	1,296	1,556	1,775	2,076
Syria	55	64	75	88	103
UAE	220	257	301	352	412
YAR	-	-	-	-	-
PDRY	-	-	-	-	-
	2,693	3,150	3,686	4,313	5,047

Source: Joint ESCWA/UNIDO Industry Division Estimate.

(1) Covers; Truck, telescopic, Cramler and Tower Cranes.

Table III-44
Construction Equipment (nos.)

Annual Demand

Country	1980	1985	1990	1995	2000
Bahrain	177	207	242	283	332
Egypt	794	929	1,087	1,272	1,488
Iraq	3,794	4,439	5,194	6,077	7,110
Jordan	182	213	249	291	341
Kuwait	530	620	726	849	993
Lebanon	-	-	-	-	-
Oman	198	232	271	317	371
Qatar	338	395	463	541	633
Saudi Arabia	7,173	8,392	9,819	11,488	13,441
Syria	428	500	586	685	802
UAE	917	1,073	1,255	1,469	1,718
YAR	-	-	-	-	-
PDRY	-	-	-	-	-
	14,531	17,000	19,892	23,272	27,229

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table III-45
Annual Demand (nos.)

ESCWA Region

Equipment	1985	1990	1995	2000
Tractors	16,361	19,525	23,298	27,826
Trucks (C.V.)	166,291	196,094	231,468	273,693
Buses	12,434	14,769	17,541	20,832
Hydraulic Excavator	629	736	860	1,007
Loaders	4,713	5,516	6,454	7,550
Cramler dozers	3,932	4,597	5,380	6,294
Motor scrapers	433	504	590	668
Motor graders	1,784	2,087	2,443	2,856
Road making plants	413	482	564	661
Compaction plants	1,950	2,280	2,668	3,121
Cranes	3,150	3,686	4,313	5,047

Source: Joint ESCWA/UNIDO Industry Division Estimate.

Table IV - 1

Common Components and Parts of
Ag. Tractors, CVs and Construction
Equipment

MD = Medium Duty; HD = Heavy Duty

	Name of item
Power Generation	
1	Diesel component: pistons
2	Diesel component: liners
3	Diesel component: piston rings
4	Diesel component: rod and mainbearing sets
5	Diesel component: gaskets and seals kit equivalent
6	Diesel component: valves and springs
7	Diesel component: engine assembly new and rebuilt
8	Diesel component: fuel pumps
9	Diesel component: fan clutches
10	Diesel component: injectors
11	Diesel component: water pumps
12	Diesel component: cylinder heads
13	Diesel component: turbochargers
14	Diesel component: charge air coolers
15	Diesel component: cranshaft
16	Diesel component: flywheer
17	Diesel component: camshaft
18	Diesel component: air pump
19	Diesel component: radiators
20	Diesel component: belts
21	Diesel component: thermostats
22	Diesel component: hoses
23	Diesel component: lube oil filters
24	Diesel component: air filters
25	Diesel component: fuel filters
26	Diesel component: mufflers
27	Diesel component: exhaust piping
28	Diesel component: exhaust clamps
29	Diesel component: exhaust flexhose
30	Diesel component: flexline hose
Power Transmission	
31	Clutches: medium duty
32	Clutches: heavy duty
33	Manual transmissions: seals/gasket-MD kit equivalent
34	Manual transmissions: seals/gasketa-HD kit equivalen
35	Manual transmissions: bearing-MD kit equivalent
36	Manual transmissions: bearing-HD kit equivalent
37	Manual transmissions: overhaul kits medium duty

38 Manual transmissions: overhaul kit-heavy duty
39 Manual transmissions: gears and shafts-MD kit equivalent
40 Manual transmissions: gears and shafts-HD kit equivalent
41 Manual transmissions: complete MD-new and rebuilt
42 Manual transmissions: complete HD-new and rebuilt

43 Axle overhaul kits: medium duty
44 Axle overhaul kits: heavy duty
45 Axle seals and gaskets: MD kit equivalent
46 Axle seals and gaskets: HD kit equivalent
47 Axle bearings sets: MD kit equivalent
48 Axle bearings sets: HD kit equvalent
49 Axle gears, shafts and pinions: MD kit equivalent
50 Axle gears, shafts and pinions: HD single kit equivalent
51 Axle gears, shafts and pinions: HD tandem kit equivalent
52 Complete differential carriers: medium duty
53 Complete differential carriers: HD single axle
54 Complete differential carriers: HD tandem axle
55 Cross and bearing kits: medium duty
56 Cross and bearing kits: heavy duty
57 Driveline/yoke: medium duty
58 Driveline/yoke: heavy duty
59 Wheel seals: grease - medium duty
60 Wheel seals: grease - heavy duty
61 Wheel seals: grease - trailer
62 Wheel seals: grease - oil bath - MD
63 Wheel seals: grease - oil bath - HD
64 Wheel seals: grease - oil bath - trailer
65 Wheel bearings: medium duty
66 Wheel bearings: heavy duty
67 Wheel bearings: trailers

Undercarriage

68 Air brakes: brake block sets
69 Air brakes: compressors
70 Air brakes: spring brakes
71 Air brakes: brake chamber
72 Air brakes: manual slack adjusters
73 Air brakes: automatic slack adjusters
74 Air brakes: brake drums
75 Air brakes: brake valves
76 Hydraulic brakes: brake lining sets
77 Hydraulic brakes: wheel cylinders
78 Hydraulic brakes: master cylinders
79 Hydraulic brakes: brake drums
80 Front end part: tie rod end - medium duty
81 Front end part: tie rod ends - heavy duty
82 Front end part: draglink and idler - medium duty
83 Front end part: draglink and idler - heavy duty
84 Front end part: kingpin sets/bolts and bushings/HD
85 Front end part: steering knuckles - medium duty
86 Front end part: steering knuckles - heavy duty
87 Springs: front - medium duty
88 Springs: front - heavy duty

89	Springs: rear - medium duty
90	Springs: rear - heavy duty
91	Springs: trailers
92	Tandem part: bushings and pins - kit equivalent
93	Tandem part: torque rods
94	Tandem part: cross tubes
95	Power steering: pumps - medium duty
96	Power steering: pumps - heavy duty
97	Power steering: seals and bushings - medium duty
98	Power steering: seals and bushings - heavy duty
99	Power steering: gears - medium duty
100	Power steering: gears - heavy duty
101	Suspension: shock absorbers
102	Suspension: air bags
103	Air brakes: air dryers - complete units
104	Air brakes: air dryers - dessicant cartridges

Electrical

105	Electrical: alternators - medium duty
106	Electrical: alternators - heavy duty
107	Electrical: starter motors - medium duty
108	Electrical: starter motors - heavy duty
109	Batteries : medium duty
110	Batteries : heavy duty
111	All types of electrical cables
112	Lamps, heads, sides, stops
113	Horns
114	Wind shield wiper
115	fuses
116	Instrument panels

TABLE IV -11

Estimated Useful Life
Selected CV Components

Category/Item	Average Replacement Milage /Miles/
AIR BRAKES	
Brake Block Sets	139,000
Compressors	210,700
Spring Brakes	172,405
Brake Chambers	151,493
Slack Adjusters - Manual	211,600
Slack Adjusters - Automatic	330,700
Brake Drums	198,800
Brake Valves	175,466
Air Dryers - Complete Units	539,180
Air Dryers - Dessicant Cartridges	76,000
HYDRAULIC BRAKES	
Brake Lining Sets	55,753
Wheel Cylenders	69,574
Master Cylenders	74,500
Brake Drums	192,200
FRONT END STEERING PARTS	
Tie-Rod End - Medium Duty	114,537
Tie-Rod End - Heavy Duty	245,600
Drag Links - Medium Duty	139,000
Drag Links - Heavy Duty	266,000
King Pins and Sets /Bolts and Bushings/ - HD	275,000
Steering Knuckles - Med.Duty	77,000
Steering Knuckles - Heavy Duty	295,741

TABLE IV -II (cont.)

Category/Item	Average Replacement Milage /Miles/
POWER STEERING	
Pumps - Medium Duty	132,800
Pumps - Heavy Duty	77,000
Seals and Bushings - Medium Duty	121,800
Seals and Bushings - Heavy Duty	161,081
Gear Sets - Medium Duty	156,700
Gear Sets - Heavy Duty	205,450
SPRINGS /STEEL/	
Front - Medium Duty /6/	246,468
Front - Heavy Duty /7-8/	246,468
Rear - Medium Duty	221,984
Rear - Heavy Duty	221,984
Trailers	269,600
SUSPENSION PARTS	
Bushings and Pins	287,700
Torque Rods	224,115
Cross Tubes /Hendrickson/	300,000
Shock Absorbers	124,800
Air Bags	217,700

The above figures based on 1985 estimate.

TABLE IV -III

Component replacement frequency
during a vehicle life-cycle

LE= Lower Estimates HE = Higher Estimates

	Average replacement mileage of components	Frequency of replacement during 10 year vehicle life	Frequency of replacement /month/
Air Brakes			
LE	76,000	7 x	17
HE	200,000	3 x	40
Hydraulic Brakes			
LE	50,000	10 x	12
HE	100,000	5 x	24
Front and Steering Parts			
LE	100,000	5 x	24
HE	200,000	3 x	40
Power Steering			
LE	77,000	7 x	17
HE	150,000	3 x	40
Springs			
LE	200,000	3 x	40
HE	250,000	2 x	60
Suspension Parts			
LE	120,000	4 x	30
HE	300,000	2 x	60

Remarks:

- Average vehicle life: 10 years /120 month/
- Average mileage of vehicle: 50,000 p.a.