OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

Distr.
LIMITED

PPD.38
10 June 1987

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

ENGLISH

STRATEGIES AND POLICIES FOR THE DEVELOPMENT OF THE CAPITAL GOODS SECTOR IN THE ARAB WORLD

Sectoral Working Paper Series

No. 58

Sectoral Studies Branch
Studies and Research Division

V.87-85879

SECTORAL WORKING PAPERS

In the course of the work on major sectoral studies carried out by UNIDO, Studies and Research Division, several working papers are produced by the secretariat and by outside experts. Selected papers that are believed to be of interest to a wider audience are presented in the Sectoral Working Papers series. These papers are more exploratory and tentative than the sectoral studies. They are therefore subject to revision and modification before being incorporated into the sectoral studies.

This paper was prepared by UNIDO consultants, Dr. J.H. Coates and Mr. M.J. Macmillen, Department of Economics, University of Exeter, England. The views expressed do not necessarily reflect the views of the UNIDO secretariat.

Preface

This document has been prepared as part of a project entitled "Techno-economic Study for the Development of the Capital Goods Industry in the Arab World" (project number UF/RAB/82/123) undertaken in co-operation with the Arab Industrial Development Organization (AIDO). The objectives of this project were to encourage the establishment of capital goods industries in Arab countries and support regional co-operation and integration.

The present study should be seen in conjunction with other documents on the same topic prepared in the project and issued by the Sectoral Studies Branch.

The study was elaborated by Dr. J.H. Coates and Mr. M.J. Macmillen, Department of Economics, University of Exeter, England, as consultants to UNIDO. Tables without specific mention of the source were prepared by the consultants.

CONTENTS

TABLES

EXPLANATORY NOTES

References to dollars ($) are to United States dollars, unless otherwise stated.

A comma (,) is used to distinguish thousands and millions.

A full stop (.) is used to indicate decimals.

A slash between dates (e.g., 1980/81) indicates a crop year, financial year or academic year.

Use of a hyphen between dates (e.g., 1960-1965) indicates the full period involved, including the beginning and end years.

Metric tons have been used throughout.

The following forms have been used in tables:

Three dots (...) indicate that data are not available or are not separately reported.

A dash (-) indicates that the amount is nil or negligible.

A blank indicates that the item is not applicable.

Totals may not add up precisely because of rounding.

Besides the common abbreviations, symbols and terms and those accepted by the International System of Units (SI), the following abbreviations and contractions have been used in this report:

Economic and technical abbreviations

GDP	Gross domestic product
LDC	Least developed country
MVA	Manufacturing value added
R and D	Research and Development
SITC	Standard International Trade Classification
t/a	Tons per annum
TCDC	Technical co-operation between developing countries
TNC	Transnational corporation

AIDO	Arab Industrial Development Organization
CAD	Computer-aided design
CKD	Completely knocked down
CNC	Computer numerically controlled
ESCWA	United Nations Economic Commission for Western Asia
FMS	Flexible Manufacturing System
GCC	Gulf Co-operation Council
GDI	Gross domestic investment
ISIC	International Standard Industrial Classification
mes	Minimum Economic Size
NC	Numerically controlled
NICs	Newly Industrializing Countries
rpm	Revolutions per minute
UHT	Ultra heat treatment
UNCTAD	United Nations Conference on Trade and Development

1. INTRODUCTION

The present study addresses the second of the three stages in UNIDO's Sectoral Studies Branch analysis of the capital goods sector in the Arab countries which UNIDO was undertaking together with the Arab Industrial Development Organization (AIDO) under the project 'Techno-economic study of the development of the capital goods sector in the Arab countries' (UC/RAB/82/123). The objectives of this project were to encourage the establishment of capital goods industries in Arab countries and support regional co-operation and integration. The Sectoral Studies Branch has issued three documents emanating from earlier studies in the project and a fourth study has been prepared by Econometric Research Ltd.[1/] The present study should, therefore, be considered in conjunction with these documents upon which it is partly based.

The second stage of UNIDO's methodological approach to sectoral studies is the definition of industrial strategies adequate for the formulation of industrial policies and the provision of a framework for later practical application of study findings. Accordingly, the main aim of the present study is to formulate strategic options and policies designed to further the development of the capital goods industries in the Arab world. The analysis is presented in such a way that the strategies and policies are amenable to examination, assessment and implementation at a variety of appropriate levels - national, sub-regional and Arab regional. Options and policies which involve regional co-operation, for example through joint venture projects, are thereby identified and discussed.

The study largely comprises a synthesis of the material and analyses contained in a number of documents prepared for the project including those already referred to. In addition, relevant papers prepared by other United Nations agencies were consulted together with a number of official national publications. Statistical material was obtained from the above as well as from primary sources. Thus, the greater part of the study is derived from secondary sources and the main documents and publications consulted in its preparation are listed in the Bibliography.

The definitions of two terms used in the study are important. Problems involved in defining and classifying capital goods are discussed in a UNIDO document from which the following quotations are taken. In the main, capital goods are distinguishable by the fact that they "cause the reproduction and expansion of the stock of social wealth and the flow of social income through their contribution to fixed-capital formation. Thus they (together with other fixed assets such as sites and buildings) fulfil the economic function of capital investment". Capital goods are "concentrated in and constitute a part of the metal-converting (mechanical, electrical, transport and engineering)

1/ Capital Goods in Perspective: Definition, Importance and Analysis of Factors Affecting Demand with Special Reference to Arab Countries, Sectoral Working Paper Series No.11, UNIDO/IS.420, December 1983. Arab Trade in Capital Goods, Sectoral Studies Series No.10, UNIDO/IS.421, December 1983. Arab Demand for Capital Goods in the Short, Medium and Long Term, Sectoral Working Paper Series No.18, UNIDO/IS.451, March 1984. Recommendations for Joint Venture Capital Goods Projects for the Arab Countries (UNIDO/internal document), April 1984.

industries".[2/] The majority of capital goods so defined are in ISIC class 38, Manufacture of Fabricated Metal Products, Machinery and Equipment. However, for a number of reasons taken together most of the discussion in the present study adopts the narrower concept of machinery and equipment as its working definition of capital goods. The first reason is that machinery and equipment constitute the core of ISIC class 38 and that, in general, it is in these products that technological considerations are especially significant. Technological issues are a major theme throughout the study.

This is not to suggest that fabricated metal products may not involve varying or high degrees of technological complexity, nor that through their forward links to other capital goods fabricated metal products should be ignored. The greater part of the Arab demand for ISIC class 38 products does, however, comprise machinery and transport equipment.

For the purposes of the study the term Arab world refers to the following countries: Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates, Yemen Arab Republic and the People's Democratic Republic of Yemen. It should be noted that recent statistical and other material relevant to the study's aims is not available for some countries especially Iraq, Lebanon, Yemen Arab Republic and People's Democratic Republic of Yemen.

The formulation of strategic options and policies relevant to the future of the capital goods sector must take into account developments in the past and the current situation in the Arab region. Therefore, following this introductory chapter, chapter 2 reviews the growth of the sector over the last 15 years or so and discusses the features of the existing capital goods sector and its contribution to meet the demands for capital goods in the region. It concludes with a general overview of the prospects for Arab capital goods industries.

The remaining chapters constitute the bulk of the study and they are essentially forward-looking. Chapter 3 identifies those strategic options, concerning the development of the capital goods sector, which may be adopted at national, sub-regional and Pan-Arab levels. All the options identified have important and far-reaching implications and therefore, the factors influencing the choice of strategy are discussed in some detail. The formulation of specific policies to be implemented in conjunction with the strategic options is the subject of chapter 4. Following a review of criteria for selecting capital goods projects, including identifying areas suitable for policy intervention, the chapter proposes policies and institutional arrangements which have as their aim the development of the capital goods industries. The final part of the chapter comprises recommendations concerning the types of capital goods products and projects which, subject to closer investigation, would appear to be viable in the Arab world. On the basis of quantitative and qualitative judgements on factors and criteria discussed in earlier chapters, the final chapter 5 makes suggestions regarding the most appropriate locations within the Arab world for the production of particular capital goods designed to satisfy the national and regional markets, through joint-venture capital goods projects.

2/ UNIDO, Capital Goods in Perspective, op. cit.

Throughout the report two related features of capital goods and their production are never far from the centre of the analysis. The first is that the demand for capital goods is a derived demand and hence their market depends to a significant extent on developments in user industries. Secondly, that as a result of backward and forward linkages, the capital goods sector has a crucial role in economic progress and development not least by means of technological advances embodied in capital goods.

2. THE SITUATION OF CAPITAL GOODS PRODUCTION IN ARAB COUNTRIES

2.1 Past trends

In the early stages of economic development and industrialization the capital goods sector typically lags behind the growth of other industries. Import substitution in manufacturing, whether policy induced or not, tends to proceed fastest in consumer goods industries. Arab countries, in general, have experienced a similar trend, so that by 1970 the unweighted average share of the capital goods sector in manufacturing production in seven countries was 11.4 per cent, Algeria, Egypt and Syria being the only countries with shares of 10 per cent or more. On the basis of the latest data the average share in the seven countries has risen to 12.3 per cent and for all countries in table 1, excluding Saudi Arabia, the share is also 12.3 per cent.

This relative stagnation reflects the fact that the Arab world has not had a comparative advantage in the production of capital goods, especially those required for the oil, gas and related industries which account for a very significant proportion of the total demand for capital goods in the region. Furthermore, the promotion of capital goods industries by governments has been less vigorous than that for other industrial sectors.

The marginal increase in the capital goods sector's share of manufacturing output does not imply, however, stagnation in absolute terms. Most Arab countries have experienced impressive real growth rates of manufacturing production since 1970 (table 1). Algeria, with the highest initial ratio of capital goods production to manufacturing production and one of the highest growth rates of manufacturing, has experienced a marked fall in the capital goods sector share. In the other two countries with relatively high initial shares the ratio rose and then fell to the initial ratio (Egypt) or to a marginally higher ratio (Syria). None of the countries with initially low shares of capital goods production in manufacturing have experienced decreases in the share. Thus, given the growth of manufacturing overall, there has been an increase since 1970 in the volume of capital goods produced in the Arab countries. Algeria is a possible exception to this.

2.2 Current situation

Preparation of this section has been hindered by data deficiencies. For the following reasons the figures in tables 1, 2, 3 and 5 should be regarded as orders of magnitude - they are not strictly comparable between countries - and should be used with appropriate caution:

(a) The definition of capital goods adopted here is machinery and equipment but some of the sources do not distinguish between these and fabricated metal products and basic metals.

(b) The figures for gross domestic investment (GDI) and value added in the capital goods sector have been derived. The former from the GDI to GDP ratio and GDP figures (gross national product for Bahrain and Qatar). Value added in capital goods was, in most cases, derived from the ratio of value added in machinery and equipment production: GDP and GDP figures; for some countries the derivation involved the ratios of value added in manufacturing

Table 1. The share of the capital goods sector in manufacturing production and the growth of manufacturing output in selected Arab countries

Country	Share of capital goods sector value-added in manufacturing value-added (percentage)				Real annual average growth rate of manufacturing output (percentage)	
	1967	1970	1975	Latest	Period	1970-1980/81/82
Algeria	18	26	23	8(1981)	1982	10.9
Egypt		14	17(1976)	14(1980)	1982	9.3
Jordan				8(1980)	1982	10.9
Kuwait		8	8	27(1981)	1981	9.5
Libya		6	4	6(1981)	1981	14.7
Morocco				9(1982)	1982	4.9
Saudi Arabia			7		1982	6.8
Sudan	6	9		9(1978)	1981	1.5
Syria		10	16	11(1980)	1980	8.2
Tunisia	5	7		11(1981)	1981	11.7
United Arab Emirates				20(1981)		
Yemen Arab Republic				12(1977)	1980	12.2
Yemen People's Democratic Republic				12(1977)		

Source: UN, National Accounts Statistics: Main Aggregates and Detailed Tables, 1982. World Bank, World Tables (3rd edition), 1984. World Bank, World Development Report (various years). Official national publications.

and the ratio of the latter to GDP. The relevant ratios come from a variety of sources, the preferred source being United Nations or World Bank publications which contain standardized statistics. It is noted that different sources give different figures for the same item.

(c) Some of the primary data are still subject to revision.

(d) Some of the ratios referred to above and import data are not available for the same year; in such cases statistics that were not within one or two years of each other, had to be used.

(e) Statistics for a single year may not be representative but the nature of the data prevented the calculation of three year averages for example.

2.2.1 Domestic production, imports and demand

Of more relevance to the present study than the growth of the capital goods sector in the past is the current level of Arab production of capital goods in relation to demand.

Of the six countries with domestic production of capital goods exceeding $US 200 million in 1981/82, only three (Algeria, Egypt and Morocco) are significant producers of machinery and equipment, the figures for Kuwait, Saudi Arabia and the United Arab Emirates include relatively high output figures for fabricated metal products (table 2). Syria and Tunisia would also appear to be not insignificant producers but the Syrian figure includes basic metal production. Therefore, at this stage of the analysis, Algeria, Egypt, Morocco and Tunisia are identified as being the largest producers of machinery and equipment in the Arab world.

The demand for capital goods is closely related to gross fixed capital formation and here GDI (including net changes in the value of inventories) is used as an indirect and imperfect proxy for demand. Lack of gross output data for the capital goods sector, inadequate export data and the fact that exports from some countries are known to be re-exports prevent the more traditional method of calculating apparent domestic consumption and hence import penetration and domestic procurement ratios. The demand for capital goods is met by domestic supplies and imports. The relevant data are presented in table 2 and the derived relationships between gross domestic investment, domestic production and imports are given in table 3. Whereas the shares in the first two columns of table 3 are influenced by differences between countries in the nature of the relationship between investment and purchases of capital goods (for example, on account of the construction element), this does not apply to the third column. However, it is known that the import figures for some countries (Bahrain, Jordan, Kuwait, Saudi Arabia and Syria) include items for re-export. Hence the figures in the third column for the re-exporting countries understate the true ratio of domestic production of capital goods to imports of capital goods for domestic use. Bearing this in mind the following analysis focuses on this ratio.

Table 2. Gross domestic investment, value added in manufacturing and capital goods production and imports of machinery and equipment in selected Arab countries ($US millions current prices)

Country	Year	Gross domestic investment (GDI)	Growth of GDI Period (1) % p.a.	Manufacturing value added	Domestic production of capital goods value added	Imports of machinery and equipment (2)
Algeria	1982	17,073	11.0	4,493	359	4,375
Bahrain	1980	956				522
Egypt	1982	7,656	15.5	7,128	998	2,488
Iraq	1978	9,900		2,100		2,260
Jordan	1980	1,046	21.6	357	30	669
Kuwait	1981	4,124	17.5	970	262	2,859
Libya	1981	9,075	10.7	851	51	4,528
Morocco	1982	3,381	9.2	2,352	212	1,036
Oman	1982	2,062		71		1,122
Qatar	1981	998		277		631
Saudi Arabia	1982	38,398	35.5	6,144	449	17,663
Sudan	1981	980	5.2	452	41	334
Syria	1980	3,096	16.7	3,354	121	888
Tunisia	1981	2,201	10.8	994	109	1,025
United Arab Emirates	1981	8,4[illegible]		2,100	420	3,139
Yemen Arab Republic	1980	1,1[illegible]	24.6	183	22	514
Yemen People's Democratic Republic	1980	279		80	10	123

Notes: (1) The growth of GDI is over the period from 1970 to the year shown against each country except for Jordan (to 1982) and Morocco (to 1980). The value figures in the other columns are for the year shown against each country.

(2) SITC (Rev 1). Where possible these are figures for special imports, that is not those for re export without significant domestic transformation.

Source: UN, National Accounts Statistics: Main Aggregates and Detailed Tables, 1982. World Bank, World Tables (3rd edition), 1984. World Bank, World Development Report (various years). Official national publications.As for table 1 plus UN, Yearbook of International Trade Statistics Volume 1, various years.

Table 3. Index numbers of gross domestic investment, domestic production of capital goods and imports of capital goods in selected Arab countries (percentage)

Country	Year	I^{MC}_{GDI} (1)	I^{PC}_{GDI} (2)	I^{PC}_{MC} (3)
Algeria	1982	25.6	2.1	8.2
Bahrain	1980	54.6		
Egypt	1982	32.5	13.0	40.1
Iraq	1978	22.8		
Jordan	1980	64.0	2.9	4.5
Kuwait	1981	69.3	6.4	9.2
Libya	1981	49.9	0.6	1.1
Morocco	1982	30.6	6.3	20.4
Oman	1982	54.4		
Qatar	1981	63.3		
Saudi Arabia	1982	46.0	1.2	2.5
Sudan	1981	34.1	4.2	12.2
Syria	1980	28.7	3.9	13.6
Tunisia	1981	46.6	5.0	10.7
United Arab Emirates	1981	37.6	5.0	13.4
Yemen Arab Republic	1980	45.8	2.0	4.3
Yemen People's Democratic Republic	1980	44.1	3.4	7.8

(1) $I^{MC}_{BDI} = \frac{\text{Imports of capital goods}}{\text{Gross domestic investment}} \times 100$

(2) $I^{PC}_{GDI} = \frac{\text{Domestic production of capital goods (value added)}}{\text{Gross domestic investment}} \times 100$

(3) $I^{PC}_{MC} = \frac{\text{Domestic production of capital goods (value added)}}{\text{Imports of capital goods}} \times 100$

Source: Derived from table 2.

The unweighted average index of domestic production of capital goods to imports of machinery and equipment is 11.4 per cent. The figure for Egypt (40.1 per cent) is three and a half times the average and is in accordance with the domestic procurement index for 1976 (table 4). Exclusion of Egypt lowers the average index to 9 per cent. Morocco is also significantly above the average. The other countries fall into two groups. The first consists of those with indexes of 10-14 per cent (Sudan, Syria, Tunisia, United Arab Emirates) and the second consists of countries with domestic production less than 10 per cent of imports (Algeria, Jordan, Kuwait, Libya, Saudi Arabia, Yemen Arab Republic, People's Democratic Republic of Yemen). Thus, of the thirteen Arab countries for which data are available only two have a capital goods industry which makes a significant contribution to national demand for capital goods. Of the countries with index numbers in the 10-14 per cent range, Tunisia is the only significant producer of machinery and equipment. It will be recalled that the United Arab Emirates's production figures include fabricated metal products; similarly the output figures for Sudan and Syria include metal production.

In the opening paragraph of this section Algeria, Egypt, Morocco and Tunisia were identified as being significant producers of machinery and equipment and these are discussed in more detail.

(a) Egypt has the highest ratios of domestic production of capital goods to imports and of domestic production to gross domestic investment of all Arab countries. This performance is impressive given that over the period 1970-1982 the average annual growth rate of gross domestic investment was 15.5 per cent (table 2) and that the growth rate of capital goods production

Table 4. Domestic procurement and export ratios for machinery and transport equipment in selected Arab countries

Country	Year	Domestic procurement index[a] (percentage)	Export index[b] (percentage))
Egypt	1976	40	1
Iraq	1975	10	< 1
Jordan	1980	10	10
Libya	1976	1	< 1
Tunisia	1979	38	9
Yemen PDR	1976	9	< 1

(a) $\frac{\text{(Gross Output - Exports)}}{\text{Apparent Domestic Consumption}} \times 100$

(b) $\frac{\text{Exports}}{\text{Gross Output}} \times 100$

Source: UNCTAD, The capital goods sector in developing countries; Technology issues and policy options, 1985, pp. 26-27, table III.2.

was relatively moderate. The growth rate of imports of capital goods other than for transport declined by 57 per cent and that of capital goods for transport declined by 79 per cent in 1975-1980 compared to 1970-1975.[3/] Thus, it is suggested that the machinery and equipment sector was relatively successful in substituting for imports as the domestic demand for capital goods increased.

(b) Morocco ranks second to Egypt on the ratio of domestic production to imports and third (after Kuwait) on the ratio of domestic production to gross domestic investment. Given that the growth rates of manufacturing production and investment have been lower than in Egypt (and most other Arab countries), this would indicate a less dynamic capital goods sector than in Egypt. However, the slow-down in import growth rates in 1975-1980 compared to 1970-1975 is greater than in Egypt. The growth rate of imports of capital goods other than those for transport declined by 71 per cent and there was an absolute decrease in imports of capital goods for transport between these periods.

(c) Tunisia has the smallest capital goods sector and the highest ratio of capital goods imports to gross domestic investment of the four countries being considered. The growth of investment was below the average for Arab countries in general but Tunisia probably experienced the highest growth rate of machinery and equipment production in the region. Between 1970-1975 and 1975-1980 the import growth rates of capital goods other than for transport, and for transport, declined by 69 and 78 per cent respectively. Tunisia's domestic procurement ratio in 1979 was only marginally below that for Egypt in 1976 and its export index was 9 per cent in 1979 (table 4) and 10 per cent in 1980. Apart from those Arab countries which are significant re-exporters, Tunisia is the leading exporter of machinery and equipment. Thus, notwithstanding its small absolute size compared to those of Egypt and Algeria, the Tunisian capital goods sector is the most export-oriented in the Arab world.

(d) Algeria, on the basis of the index number of domestic production to investment and to imports, compares unfavourable with the other three countries and indeed, with the majority of other Arab countries. However, it is by no means clear that the Algerian figures for 1982 in table 3 are typical. For example, in 1981 the index of domestic production to investment was also relatively low (3 per cent) but the index of domestic production to imports was 11.5 per cent, 40 per cent higher than the 1982 figures and above that for Tunisia. Although the growth of gross domestic investment was higher than in Morocco and marginally above that in Tunisia it will be recalled that there is no evidence of any significant sustained real growth in capital goods production in Algeria. Nevertheless, the import growth rates of the two categories of capital goods referred to declined by 76 and 68 per cent respectively between the two periods.

3/ The import growth rates for Egypt, Morocco, Tunisia and Algeria were taken from UNIDO, Arab Trade in Capital Goods, Sectoral Studies Series No.10, December 1983.

The general conclusion from this section is that the majority of Arab countries are insignificant producers of machinery and equipment and that their domestic output is low compared to the demand for and imports of capital goods.

2.2.2 Employment and industrial structure

Employment data confirm that the capital goods sector in Egypt and Algeria are the largest in the Arab world (table 5). In view of the analysis in the proceeding section the lack of complete data on employment and establishments for Algeria and Morocco is especially regrettable. Furthermore, lack of information prevents any discussion of value added per establishment and per worker in manufacturing and capital goods production for recent years.

Employment per establishment is, on average, low in manufacturing in general and in the capital goods sector in particular, taking into account the fact that the data in table 5 are confined, for most countries, to the larger establishments (typically those employing more than 10 persons). This is not the case for Syria resulting in the extremely low figures for that country. Establishments in the capital goods sector are smaller or similar in employment terms to those in manufacturing as a whole. The exceptions are plants in Egypt, Iraq and Tunisia and these are the countries with the highest employment per establishment ratios for the capital goods sector.

2.2.3 Current production of machinery and equipment

Information on the range of capital goods produced, plant capacities and output volumes is limited. It is reported (see chapter 6) that Arab production of the following is insignificant: construction and mining equipment, mechanical handling equipment, mineral processing machinery, air conditioning machinery and textile machinery. The lack of significant capacity in construction equipment and textile machinery is noteworthy given the high rates of construction activity (especially in the oil producing countries) and that textile manufacturing is one of the largest consumer goods industries in the Arab world.

Available information on machinery and equipment items currently produced and planned is given in table 6 and in subsequent paragraphs.[4/] Non-inclusion of other items in table 6 does not necessarily mean that they are not currently produced in the Arab world or that their production is not being planned. Similarly, exclusion of particular countries should not be interpreted as implying that there is no current or planned production of the items in the table in these countries. Only those countries which produce or plan to produce two or more of the items are included in the table. Before proceeding to details on these items two features are apparent from table 6. First, Algeria, Egypt, Morocco and Tunisia each produce or plan to produce across the entire product range with the exception of Egypt (construction equipment). This further justifies the earlier conclusion that these four countries possess the most developed machinery and equipment industries in the

---

4/ The data sources for these paragraphs are those for table 6, unless stated otherwise.

Table 5. Employment and establishments in the manufacturing and capital goods industries in selected Arab countries

Country	Year	Employment			Establishments			Employment per establishment	
		Manufacturing	Capital goods	Share (%)	Manufacturing	Capital goods	Share (%)	Manufacturing	Capital goods
Algeria	1978	231,800	85,450	37					
Bahrain	1982	16,500							
Egypt	1976	754,200	92,767	12	4,888	499	10	154	186
Iraq	1976	142,700	14,495	10	1,479	131	9	96	111
Jordan	1981	37,100	4,830	13					
Kuwait	1978	43,272	5,207	12	3,439	403	12	13	13
Libya	1976	13,843	415	3	271	19	7	51	22
Morocco	1978	47,400							
Qatar	1982				334	89	27		
Saudi Arabia	1980	61,087	14,513	24	1,183	299	25	52	48
Sudan	1970	48,027	4,082	9	1,247	296	23	38	14
Syria	1978/80	186,200	16,758	9	34,542	5,147	15	5	3
Tunisia	1980	124,537	17,311	14	1,408	151	11	89	115
United Arab Emirates	1981	30,563	7,538	25	654	165	25	47	46
Yemen People's Democratic Republic	1977	7,744	912	12					

Source: ILO, Yearbook of Labour Statistics, 1983. World Bank, World Tables, (3rd edition) 1984. Official national publications.

Table 6. Machinery and equipment produced in Arab countries

X Existing Capacity P Planned Capacity

[illegible]	Pumps and valves	Boilers	Diesel Engines	Machine Tools	Trans-formers	Construction Equipment	Agricultural Tractors	Commercial Vehicles
Algeria	X	X	X	X	X	X	X	X
Egypt	X	X	X	X	X		X	X
Iraq					X		X	X
Libya					X		X	X
Morocco	X	X	X	X	X	P	X	X
Saudi Arabia					X	P	X	
Syria							X	P
Tunisia	X	X	X	X	X	P	X	X

Source: UNIDO, Data on Installed and Planned Production Capacities, Consumption, Imports and Exports of Manufacturing Industries and Electricity in Arab Countries, May 1984.

The Economist Intelligence Unit, The Development of the Capital Goods Sector in the Arab Countries, Volume 5, Monographs on Potential Joint Projects, Draft Report, May 1983.

Econometric Research Ltd./UNIDO, Recommendations for Joint Venture Capital Goods Projects for the Arab Countries, April 1984.

Arab world. Second, the automotive group of items (agricultural tractors, commercial vehicles, construction equipment and diesel engines) is especially strongly represented.

(a) Pumps and valves

Current production of the following countries is equivalent to about 5 per cent of Arab demand.

Algeria: Centrifugal and high pressure pumps, valves.
Egypt: Irrigation pump sets, taps, valves, pumps and castings.
Jordan: Valves.
Morocco: Pumps (current output 1,750 units/year).
Tunisia: Pumps (current output 4,000 units/year).

(b) Boilers

Egypt, Morocco and Tunisia: Small packaged boilers and furnaces.
Algeria: Small boilers.

(c) Diesel engines

Algeria: 1 manufacturer of engines for tractors, trucks and stationary equipment (capacity 10,000 units/year).
Egypt: 2 manufacturers of engines for irrigation pumps, welding and standby generators.
Morocco: 2 assemblers of completely knocked down (CKD) kits.
Tunisia: 2 assemblers of CKD engines for dumper trucks and pumps.

All engines produced are of foreign design.

(d) Machine tools

Algeria: Lathes, milling machines and drills (output 700 units in 1981).
Egypt: Lathes, milling, shaping and grinding machines and presses (output 1,000 units in 1981).
Morocco: Joint venture plant (with Tunisia) for production of lathes and milling machines due to have been completed in 1983.
Tunisia: Metal folders and cutters (output 1,500 units in 1980).

Current production accounts for less than 10 per cent of Arab demand.

(e) Transformers

Algeria: Small transformers (quoted capacity of 10,300 units/year).
Egypt: Distribution transformers.
Iraq: 1 plant, largely an assembly operation producing oil transformers.
Libya: Assembly operation.
Morocco: 2 plants capable of supplying the national market for distribution transformers plus some export.
Oman: Proposals for an assembly operation.

Saudi Arabia: 3 plants (combined capacity of 5,000 units/year), one of which is probably largely assembly employing 100 persons and producing 2,400 units/year.
Tunisia: 1 assembly plant (quoted capacity of 3,500 units/year).

(f) Construction equipment

Algeria: 1 plant to produce 900 hydraulic excavators and 300 mobile cranes per year due to have been completed in 1984.

(g) Agricultural tractors

Current capacities (units/year)

Algeria:	10,000	Morocco:	3,000
Egypt:	5,000	Saudi Arabia:	1,500/1,800
Iraq:	5,000	Sudan:	3,000
Libya:	5,000	Syria:	6,000
Tunisia:	6,000		

There is one plant in each country. With the exception of Algeria and Egypt the operation is assembly. The Egyptian operation is combined manufacturing and assembly. The Algerian plant is the only real manufacturing operation with 80 per cent local sourcing and there are plans for the plant's extension. The installed capacity in the above countries is sufficient to meet current Arab demand but current production volumes are well below capacity, for example the Algerian output was 4,500 units in 1982.

(h) Commercial venicles[5/]

Production of all commercial vehicles is reported as follows (units/year):

Algeria:	7,200 (1983)
Egypt:	8,300 (1983)
Morocco:	1,700 (1981)
Tunisia:	9,900 (1984)

The truck output and capacity is given in table 7.

Thus, about three-quarters of the Algerian commercial vehicles production is accounted for by trucks whereas for Egypt the equivalent figure is just over a third. The figures for Morocco suggest that truck output increased significantly between 1981 and 1983. The figures for Tunisia indicate that truck output is about 10 per cent of total commercial vehicles production. It may be noted that Egypt, Morocco and Tunisia assemble passenger cars from imported parts: respective production figures are approximately 23,700 (1983), 16,000 (1981) and 2,300 (1984).

5/ United Nations, Monthly Bulletin of Statistics, November 1985.

Table 7. Truck output and capacity in units, different years

	Total units	Output year	Plant	Production operation	Capacity (units/year)
Algeria	5,540	1982	1	manufacturing	8,000 (10,000 projected)
Egypt	3,000	1983	1	manufacturing/assembly	3,000
			1	assembly	7,100
			3	assembly plants being built or studied	31,500
Iraq	2,800	1979	1	assembly	3,000 (10,000 projected)
Kuwait			1	assembly	1,000
Libya			1	assembly	3,900
Morocco	5,760	1983	3	assembly	
Saudi Arabia			1	assembly	6,500
Syria			1	assembly plant planned	4,000
Tunisia			2	assembly	1,000+

In the introduction to this section the lack of any significant production of air conditioning equipment was noted. It is presumed that this refers to non-household air conditioners with a combined output of 278,000 units/year (1979/1982), Egypt accounting for nearly one half and Saudi Arabia accounting for over a quarter of the total production. Thus, there is considerable experience in the Arab world of producing these items and the technological complexity of domestic and industrial units is not dissimilar. The same point is valid for refrigeration equipment. Eleven Arab countries produce refrigerators, the combined output being 773,000 units in 1979-1983 with Algeria, Egypt, Iraq and Syria accounting for three-quarters of the total.

This section has shown that, for the standard machinery and equipment items for which some detail is available, the capital goods sector in the Arab countries is characterized by a small number of plants per item per country. The majority of plants are assembly operations frequently operating below capacity and some of these capacities are reported to be below minimum economic size. Given that the demand for the items in the Arab region is well in excess of current production the reasons for capacity underutilization might include inappropriate products, inadequate marketing, procurement problems and in-plant inefficiency.

2.3 Prospects for the capital goods sector

The outlook for the capital goods sector in the Arab world depends upon a wide range of factors including the current state of the sector, the strategies and policies to be adopted for the development of the sector and

related sectors, general macroeconomic and trade policies, technological and commercial developments relating to capital goods outside the Arab region and general developments in the world economy.

The preceding sections of this chapter and other sources indicate that, notwithstanding its growth in the past, the Arab capital goods sector as a whole is currently small, less developed and internationally uncompetitive - the three features being very closely inter-related.

The sector is small. Output is low in absolute terms and in relation to the total demand for capital goods in the Arab region; individual industries are small comprising a few plants with capacities frequently below minimum economic size (m.e.s.); rates of capacity utilization are low.

The sector is less developed. Production being confined to a limited number of product types and within these the product range is typically narrow. The technological complexity of products and production processes is low, output consisting of standardized items of machinery and equipment with assembly being the most common production method. The engineering infrastructure is also under-developed so that, although the capital goods produced are of low technological complexity, backward linkages are weak and the rate of local sourcing is low. The sector relies heavily on foreign suppliers and manufacturers for material inputs and technology, indigenous technological initiatives having been limited.

The lack of international competitiveness is demonstrated by sales being typically confined to national markets and exports to other Arab and non-Arab countries are minimal.

Given the rapid growth of the regional market for machinery and equipment since the early 1970s, one of the main reasons for the current state may lie on the supply side, broadly defined. With Arab demand expected to continue to grow, albeit at a slower rate than in the past, concentration on supply side issues is further justified. Growth and technological development of a capital goods sector make heavy demands on particular factor inputs and a wide variety of services (see chapter 6) and Arab countries have either not been well endowed with these requirements or they have chosen to channel resources in other directions. Planning strategies and policies adopted in the past have not been particularly conducive to the development of the sector (see chapter 3). For some countries the foreign exchange earnings from oil and related activities have raised the exchange rate resulting in other sectors, including capital goods, being less price competitive. There can be no doubt that the Arab countries as a group have not had a comparative advantage in equipment and machinery production.

Whether they will have a comparative advantage in the future depends in part upon factors exogenous to the region such as developments in the capital goods sector in other countries and developments in the world economy in general. Comparative advantage in capital goods is significantly affected by indigenous technological capability and therefore prospects for the sector in Arab countries partly depend on the availability of resources for the growth of the sector and its technological up-grading. A detailed country-by-country and industry-by-industry study would be necessary to reach definitive conclusions on these issues but the following analysis may be illustrative.

Algeria is a major oil exporter and it has a significant capital goods sector base compared to the majority of Arab countries. Thus, notwithstanding its current external indebtedness, it has financial and foreign exchange resources and experience in capital goods production, and these features suggest that it has the potential to revitalise its capital goods industries which have stagnated in the last decade or so. The other major oil exporters (for example, Kuwait, Libya, Qatar, Saudi Arabia and the United Arab Emirates) possess insignificant capital goods industries. Notwithstanding the fall in export earnings from oil in recent years, they have the financial resources for the development of a capital goods sector. Resources can be directed to the sector by means of import controls (including tariffs) or by direct subsidy: the latter policy is preferable because it does not have the distorting effects on the rest of the economy which result form the imposition of import controls. The production of basic metals has commenced in some of these countries and this provides a potential linkage with a capital goods sector.

Egypt, Syria and Tunisia are net oil exporters and although Syria has some capital goods and basic metals production its capital goods sector is smaller and less developed than those of the other two countries. Thus, Egypt and Tunisia, especially the former with its greater oil revenues and greater experience in capital goods production, are in a relatively favourable position to technologically up-grade their capital goods industries.

Whereas increased oil revenues would benefit the Arab region as a whole, including some non-oil countries because of their reliance on oil exporters as a source of workers' remittances and exports, rising oil prices would raise the import bill of the oil importing countries (for example, Jordan, Morocco and Sudan). Of these only Morocco has significant experience in machinery and equipment production and hence the availability of resources for developing the capital goods sector will depend significantly on the country's overall macroeconomic and export performances. Low income and resource poor countries such as the Sudan are unlikely to become significant competitive producers of capital goods. Any production is likely to be confined to a narrow range of products adapted to their particular needs and resource endowments.

A further source of financial resources should not be ignored. The potential surpluses of existing capital goods industries could be realised by raising productivity throughout the entire production chain. It is essential to identify the origins and causes of existing capital goods industries' low productivity, distinguishing between those which are internal and those which are external to plants producing final capital goods. The outlook for the production of machinery and equipment will not be encouraging and the allocation of further scarce resources to the capital goods sector would not be appropriate unless in-plant efficiency is raised and establishments have access to reliable electricity supplies, transport etc. which is currently not the case in all Arab countries.

3. FORMULATION OF STRATEGIC OPTIONS FOR THE DEVELOPMENT OF THE CAPITAL GOODS SECTOR IN THE ARAB WORLD

3.1 Introductory remarks

This chapter aims to provide guidance on the choice of strategies available to Arab countries, acting individually and through multilateral co-operation, designed to enable Arab countries to establish a capital goods sector and to foster the development of an existing base of capital goods industries. Following the identification of possible strategic options, the main body of the chapter is devoted to an analysis of the factors which influence the choice of strategy.

Prior to this discussion there are a number of general points relevant to the capital goods sector and to the formulation of strategic options which should be taken into account by policy-makers.

The capital goods sector has the potential to play a key role in the processes of economic development in general and industrialization in particular. This role derives from the fact that the sector's output is an input into every other production activity and therefore it has an important influence on the cost structure of the economy as a whole. Although difficult to quantify, there is no doubt that the embodiment of new technologies in capital equipment is a very significant contributor to raising factor productivity and hence to overall economic growth in absolute and per capita terms. As economies mature there is less scope for increasing economy-wide factor productivity by the reallocation of resources between activities and the potential for the capital goods sector to raise productivity in other sectors thereby increases.

The ability of an indigenous capital goods sector to contribute in this way to economic progress depends on the technological awareness and capabilities of industries both backward- and forward-linked to the sector. If user industries cannot perceive ways by which new or technologically modified capital goods could raise productivity or lower costs or are not able to operate and maintain more technologically advanced machinery and equipment, the demand for technologically improved capital goods will not exist. This would reduce the incentive in the capital goods sector to design and produce more technologically advanced products. In turn this would hinder technological progress in activities which supply the capital goods sector and reduce the need to raise the quality of raw materials.

Similarly, if industries which supply the capital goods sector are themselves unable to respond to the changing requirements of the sector or are unable to initiate changes in their products, then the capital goods sector will either become more dependent on imported inputs or be unable to act as one of the main vehicles for technological development in forward-linked activities.

It is, therefore, highly desirable that planning for the development of the capital goods sector is not undertaken in isolation. Efforts to promote one sector or industry will be hindered by a lack of responsiveness in upstream sectors or industries. The capital goods sector and other industries

will turn to foreign suppliers if indigenous suppliers are unable to produce the quantity and quality of the inputs they require at competitive prices. The relieving of such constraints by imports is dependent upon the availability of foreign exchange and therefore it is imperative that production in all sectors be in accordance with long run comparative advantage. The demand for capital goods in total and as between products will depend not only on the general macroeconomic policy but also on the extent to which the development of activities upstream and downstream of the sector is being and will be planned in terms of comparative advantage.

Capital goods sector projects typically have longer gestation periods than those in other sectors. Accurate forecasts of factors influencing demand and cost conditions are therefore essential. This forecasting requirement is reinforced by the relatively long physical lives and the relatively low ex-installation elasticities of factor substitution. Furthermore, the demand for capital goods fluctuates more than for the output of final product industries (although less than for the demand for primary commodities, unprocessed and processed). Variability in demand suggests that there is more risk attached to the production of capital goods than some other products and this will cause greater problems in countries characterized by weak demand forecasting techniques and limited managerial skills (for example in stock control and production planning). To some extent the variability in Arab demand may be compensated for by the greater stability of the world market. However, the great majority of Arab producers of capital goods are unlikely to be able to take advantage of selling outside the Arab region in the foreseeable future.

Developments in the world capital goods markets are relevant to the formulation of a policy designed to promote the Arab capital goods sector. The world recession has resulted in the emergence of considerable excess capacity in several capital goods industries at the global level. How long this situation prevails will depend on the rate of scrapping of plant and on the recovery in world demand. Depressed world demand and excess capacity has led some producers in the industrialized countries to lower prices, in some cases under the pressure from sales of second-hand equipment and others to be more reluctant to conclude agreements with enterprises in other countries which would result in erosion of their markets or technological leads. Thus, it is important that countries considering entry into capital goods production or considering entering new product lines should closely monitor developments in capital goods markets at the global level.

Trends in supply side factors of the capital goods sector in the industrialized countries should also be reviewed. This is not done in order to prescribe a model which Arab countries and enterprises should follow but to make policy-makers and potential new entrants aware of certain developments which have enabled the world's leading suppliers of capital goods to maintain their cost and technological advantages.

3.2 Identification of strategic options

The analysis in chapter 2 demonstrated that, with the (possible) exception of Algeria, Egypt, Morocco and Tunisia, the output of the capital goods sector in Arab countries is insignificant in absolute terms and in relation to national demand and in terms of the sector's share in national product. Therefore, for the majority of Arab countries the development of the

sector is primarily concerned with initiation rather than building upon an established base. Even in those countries which do possess an infant capital goods sector it is typically narrowly-based (consisting of a limited number of industries or single plants) assembling or manufacturing standard equipment of low technological complexity with few or weak links with other indigenous producers. Especially significant is the limited capacity of the local engineering infrastructure.

On account of the similarly less developed nature of the capital goods sector in the majority of Arab countries the range of strategic options that may be considered for the development of the sector is common to these countries. The range of options is wider for those countries which already possess economically efficient capital goods industries. The actual choice of options will vary from product to product, or industry to industry and between countries and will depend upon the factors discussed in the next sections.

Strategic options may be classified in several ways: the approach adopted here is a simple two-dimensional classification which accommodates those factors considered to be of particular importance in the choice of option. One classification, the Product-Process-Technology spectrum of options, is based upon the production process and technological characteristics of capital goods products. Details of the Product-Process-Technology options will be given in section 3.4, but essentially the higher the column number in the matrix, the more technologically complex is both the product and the production process and this has very significant implications for factor inputs and backward linkages. For the majority of Arab countries higher numbered options involve progressively greater technological leaps and hence more reliance on either foreign technology or more intense efforts to up-date indigenous technological capabilities (see table 8)

The second classification, corresponding to the rows in the matrix, takes account of the following:

(a) For many capital goods the minimum economic plant size (m.e.s.) is greater than individual national market demand;

(b) The factor input requirements for a m.e.s. plant may be greater than individual national supply; and

(c) Some product-process-technology options will require, or be aided by, technology transfers from established non-Arab enterprises, mainly in the industrialized countries but also in the most advanced industrializing developing countries. Thus, the nationality involvement spectrum recognises that, for some capital goods, economically-efficient production would have to be on a sub-regional or Pan-Arab basis rather than on a national basis (the approach thereby accommodates the interest in inter-Arab co-operation) and that third countries' participation in the form of technology transfer agreements may be necessary.

Table 8. Strategic options for the development of the capital goods sector in the Arab world: identification matrix

Nationality involvement spectrum	Product-process-technology spectrum			
	Assembling	Manufacturing		
	Assembly 1	Simple technology 2	Intermediate technology 3	Complex technology 4
1. National				
2. National + non-Arab				
3. Arab sub-regional				
4. Arab sub-regional + non-Arab				
5. Pan-Arab				
6. Pan-Arab + non-Arab				

Options towards the south-east of the matrix are both technologically and organizationally (on account of the greater degree of inter-Arab co-operation envisaged) more advanced. In principle, twenty-four (4 X 6) options are identified but the number of practical options will be less than this. For example, the complex technology strategy would be restricted to either a few Arab countries (those with an efficient, established capital goods sector) or to some form of inter-Arab co-operation based on those countries and would certainly require technology transfers.

The matrix would be used for planning on an industry by industry, or preferably on a product by product, basis. For example, for one product or narrow product range the appropriate strategy would be assembly on an Arab sub-regional basis whereas for another it would be the manufacture of complex technology products in one or two countries. The appropriate sub-region for one product (or product group) will not necessarily coincide geographically with that for another.

To the extent that the chosen strategies for individual products (or product groups) are translated into a formal plan or programme for the development of the capital goods sector, it will be essential to ascertain the internal consistency of the set of strategies and to assess the programme's overall requirements for finance, foreign exchange, manpower etc. in relation to respective availabilities at national, sub-regional and Pan-Arab levels. The feasibility of inter-Arab co-operation will also have to be explored.

3.3 Factors influencing the choice of strategic options I: demand, factor inputs and project phasing

3.3.1 Demand

For the current purpose the potential demand for the Arab capital goods sector is taken as the Arab market given the limited capability to export outside the Arab world at least in the short term. However, a longer perspective would suggest that a wider market be considered because the capital goods sector's potential to become a net foreign exchange earner should be an important factor especially for non-oil producing countries and for those with limited oil reserves.

An important influence on the choice of product is the ratios of national, sub-regional and Arab market sizes to the capacity of m.e.s. plants. A national plant will not be viable if the capacity of a m.e.s. plant is greater than the national market unless it serves a wider market. The relationship between m.e.s. plant capacity and market demand can only be validly examined at the level of single products, parts or components, or very close substitutes.

The volume of total Arab demand for capital goods must be disaggregated as finely as possible for other reasons. First, the nature and extent of inter- and intra-industry linkages become significantly more apparent at the specific product (or group of products) level. Second, the distinction between standard and non-standard machinery and equipment is very relevant to the Product-process-technology strategy choice. Third, Arab countries do not have identical relative factor endowments and therefore, the same user industries in different countries will require different types of capital goods if development proceeds in accordance with comparative advantage.

Simple extrapolation of the growth of Arab demand experienced in the 1970s will not provide accurate estimates of future demand. This method ignores factor input substitution possibilities and the fact that demand is influenced by capacity utilization rates in user industries. More efficient use of existing and new plant and equipment would lower demand for capital goods. In recent years GDP has stagnated or grown much more slowly and public sector investment plans are correspondingly less ambitious than previously. Investment in some user industries, for example transport infrastructure and electricity generation and transmission, has been especially uneven with installed capacity being greater than the expected short term demand. It is expected, therefore, that the ratio of replacement demand to new demand (which varies between capital goods and, for a particular capital good, between different parts and components) will increase.

A high replacement:new ratio raises the overall stability of demand and this is a very important factor in the choice of product and strategy because demand instability raises production costs. The demand for standard capital goods fluctuates less than those produced to customer specification and design. The Arab countries would be advised therefore to concentrate on the production of standard equipment and machinery. This is reinforced by the fact that the majority of Arab countries do not have and will not have in the foreseeable future, the technological capability of producing non-standardized capital goods which are technologically more complex.

3.3.2 Factor inputs

(a) Physical capital outlays

Although capital goods industries have non-identical physical capital:output ratios, projects of m.e.s. are typically intensive in fixed plant and equipment. Outlays are large and the ability to finance developments in the capital goods sector, taking into account their foreign exchange requirements, varies considerably between Arab countries. In addition to national savings, finance may be available on commercial terms from foreign manufacturers (for example under technology transfer agreements) and on concessional terms from certain Arab countries and multilateral Arab aid agencies; a number of countries may be eligible for bilateral and multilateral aid from other donors.

On account of the sector's dependence upon developments in both user and supplier industries and of initial low in-plant productivity, capacity utilization rates will be low in the short term. The estimation of fixed investment:output ratios should reflect this and unmodified data from established manufacturers in industrialized countries should not be used in detailed project appraisal.

(b) Human capital outlays

It is generally agreed that a sound physical engineering infrastructure and a highly skilled labour force are essential preconditions for entry into capital goods production. With the exception of unskilled labour[6/] and possibly pure entrepreneurs, all categories of personnel require training or specialized education. Capital goods industries differ in terms of the level and mixes of required skills. Training and skill acquisition takes time and because on-the-job facilities are severely limited in the Arab world it must be provided prior to the project going onstream. Sources of human capital for the capital goods sector in Arab countries include the formal education system, underemployed personnel in other sectors, those currently engaged in embryonic capital goods and repair and maintenance industries and, for some countries, returning migrants from Western Europe. The incremental requirements for all types of qualified manpower must be examined in relation to the expected Arab supply of these categories of manpower and education and training programmes should be undertaken and phased accordingly. Manpower shortages will result in either the non-implementation of projects, or their operation at low capacity utilization rates or the use of foreign manpower.

Detailed data on qualified manpower in Arab countries are not available but countries with limited availabilities will be constrained to those options at the lower end of the Product-process-technology spectrum. However, in order to ensure that the capital goods sector is able to progress up this

---

6/ The present study does not regard unskilled labour to be a serious constraint on the development of the capital goods sector except in some of the oil producing countries. The latter have imported unskilled labour, the majority of it from other Arab countries and there is scope for inter-Arab co-operation in the form of pooling resources of this input. Unskilled labour may substitute for capital and labour in materials handling.

spectrum, provision must be made for further education and skill development (both on and off the job). Young, qualified personnel require clear career development paths in order to prevent loss to other occupations or sectors and the horizontal spread of small enterprises which lack scale advantages.

There are economies of specialization and scale in training and education and therefore there is scope for co-operation between Arab countries in the provision of appropriate facilities. The location of the facilities - at national, sub-regional or regional levels - will depend upon the demand for manpower of various types and upon supply factors.

Entrepreneurship is a critical input in any production activity and it is characterized by the taking of risk associated with product innovation (including initial entry into production) and process innovation. In theory it is thus distinguishable from management but lack of data on the quantity and quality of entrepreneurship and management constrains discussion here to broad generalizations.

First, inclusion of management and entrepreneurship under the current heading is justified because of the prior outlays involved in areas such as the development of specific skills (for example, in production planning and foreign technology acquisition) and institutions (for example, those that provide information on market and technology developments). Furthermore, an appropriate business environment covering legal, financial and employee matters must be established.

Second, options at the upper end of the product-process-technology spectrum require higher quality entrepreneurship and management because of the greater degree of risk and technological complexity involved. On the other hand, simple assembly is a relatively low risk operation and efficient plant management is relatively more important than entrepreneurial talent.

Third, scarcity of management and entrepreneurial talent may be overcome by the use of foreign experts or by the more efficient use of existing Arab resources, for example by redeployment of under-employed managers and administrators and by concentrating existing and new entrepreneurs and managers in larger scale sub-regional, Pan-Arab or national projects. In addition, factors which hinder entrepreneurial activity and discourage entry into the management of industrial enterprises should be identified and appropriate policy reforms implemented.

3.3.3 Recurrent outlays

(a) Engineering infrastructure, intermediate products and backward linkages

A basic physical engineering capability is an essential requirement for capital goods production. Even the simplest of assembly operations depend upon a minimum capability to repair and maintain plant and tools. Beyond this critical minimum, capital goods industries vary in terms of the technological sophistication and production capability required of the engineering infrastructure but all need access to a mix of metal working (forging, pressing, casting, welding and machining) and general fabrication facilities.

The quality of final capital goods depends in part on the quality of both the raw materials used and their transformation into parts and components. The physical engineering infrastructure therefore requires its own complement of skilled labour to perform a wide range of specialist tasks. The engineering facilities may be located in-plant or independently; factors influencing the choice include how captive the facility is to a particular capital goods producer or group of producers and the significance of scale economies and transport costs. If independent facilities are deemed appropriate, their establishment should be considered a separate project for planning purposes.

Generally speaking, the current state of the physical engineering infrastructure in Arab countries reflects the current state of development of the capital goods sector as a whole in those countries. Thus, the majority of countries possess limited capability in this area and it should be noted that the complex technology option requires an engineering infrastructure of comparable technological capability to that in advanced industrialized economics. Irrespective of the option or options chosen, the enhancement of physical engineering facilities will be an early objective of the highest priority. Each country, even if it does not possess a comparative advantage in the production of capital goods, should have some capability in this area in order to provide repair and maintenance services. Provision of these facilities will reduce the need to import replacement parts and components and, in addition, the engineering infrastructure could meet a higher proportion of the demand for metal structures than at present.

The ability to raise the Arab content of capital goods production through Arab sourcing of parts and components depends on the successful development of upstream activities. Substitution of local for imported components in the manufacture or assembly of capital goods produced under an agreement with a foreign manufacturer will require prior agreement of the licenser in order to ensure that local inputs meet quality standards.

The decision outcome on buying-in or subcontracting vis-à-vis in-plant manufacture will differ between individual capital goods or between groups of capital goods related by product similarities, common inputs and similarities in manfuacturing operations. In-plant manufacture (or importing) of parts and components by the capital goods producer may be necessary or desirable initially for a number of reasons. These include the inability of local firms to produce the required quantity of inputs, the scale of operations may be below the m.e.s. for an independent supplier, the absence of efficient procurement channels, the need to ensure adequate quality control and a perceived inability of indigenous component suppliers to technologically up-grade their products. Any one of these could be a binding constraint on buying-in. Special attention must be paid therefore to the capabilities of potential component suppliers before a commitment is made to a high Arab sourcing strategy.

Such a strategy will be the more successful the greater the degree of standardization of products and components because suppliers will be able to achieve economies of scale and risks facing component suppliers will be lower. Standardization of capital goods and their components and parts in the Arab world will facilitate entry into the manufacture of replacement parts and

components by Arab suppliers. Furthermore, certain types of capital goods (especially those in the automotive group) can be built on a modular basis using standard parts and components in common. Paradoxically, concentration on fewer final products increases the number of interlinkages and common components and parts.

A close examination of potential forward and backward linkages will also be essential for investigating the feasibility of splitting up the sequential nature of standard capital goods production between several vertically-linked but locationally separate plants. This is important in the context of inter-Arab co-operation and joint projects. However, a strategy involving the allocation of different stages of production between several countries must take into account the costs of transporting precision components and those with low value:weight ratios.

It is appropriate to include raw materials in this sub-section but information is limited to the situation in the Gulf Co-operation Council (GCC) countries and a few others. The former produce copper (from indigenous deposits) and iron/steel and aluminium (from imported crude materials) and possess deposits of iron ore, bauxite and alumina-rich clays. Other sources of raw materials include Algeria (iron ore deposits and iron/steel production; copper deposits), Egypt (iron ore deposits and iron/steel production; aluminium production), Iraq (iron/steel production), Libya (iron/steel production), Morocco (iron ore deposits and iron/steel production; copper deposits), and Tunisia (iron ore deposits and iron/steel production). Metal refining (especially aluminium) is energy intensive and it is expected that this activity will be concentrated in energy abundant countries. The reliability and performance of capital goods depend in part on the quality of the raw materials used in their manufacture.

(b) Specialist technical services

The capital goods sector requires access to a host of specialist services, some of which are related to the day-to-day or short term operations of producers whilst others are essential for the longer term technological development of the sector and are related to R + D and product design capabilities. These services include information services (markets, input sources, product design, manufacturing technologies, terms of technology transfer agreements), laboratory and testing facilities, product quality control and certification and after sales service.

Services required for day-to-day operations (for example, quality control and testing) will be undertaken in-house whereas others, especially those relating to information, may be more appropriately organized on an industry-wide basis at a sub-regional or Pan-Arab level. Products with demanding specifications, for example relating to safety and reliability, require certification from an external standards authority. Initially it would be advisable to adopt the established standards of the industrialized countries but for products with no such standards there is a case for establishing Pan-Arab standards. The institutional and financing/charging arrangements for services supplied by agencies external to the individual firm would depend, therefore, on factors such as the scope for economies of scale

in services provision, the possibilities for inter-firm co-operation (for example, producers associations) and inter-Arab co-operation and on the promotional policy of government towards the sector (subsidies to services).

Successful entry into capital goods production requires prior provision of a minimum range and quality of technical services, the minimum being lower for assembly operation. More technologically complex strategic options need more extensive and higher quality services. Whatever strategic option is chosen it is essential that the provision of technical services is not regarded as a static exercise - they must be able to respond to the changing needs of the capital goods sector as it attempts to enter new markets, to increase penetration of existing markets and to produce products of greater technological complexity.

(c) Power

The majority of Arab countries are not significant producers of oil and gas and non-petroleum energy sources are not well developed. Furthermore, the hydrocarbon resources in some countries are expected to be exhausted within one or two generations. Thus, it is essential that energy-efficient products and processes in the capital goods sector are identified and selected. In the industrialized countries changes in relative input prices have induced energy-saving innovation and Arab producers of machinery and equipment must be able to compete with imports which embody high energy efficiency. The appropriate pricing of power is an important element in project appraisal and the power requirements of potential capital goods sector projects should be given more attention than hitherto.

(d) Water

The immediately preceding point applies equally to water. Even though water is relatively scarce throughout most of the Arab world it is typically supplied at zero or nominal price. Information on the water requirements of the capital goods sector is lacking but they are suspected to be relatively high in the metal working processes of the engineering infrastructure.

(e) Location, transport and environment

These factors are considered in this section on account of their associated capital and current outlays. The importance of transport costs in relation to the possibility of locating vertically-related but geographically separate plants has been referred to. Transport costs may dictate a location close to major markets or to established engineering infrastructure and input industries. All capital goods projects must be served by adequate transport facilities (usually road and port) and have access to reliable supplies of water and power. Close proximity to deep water port facilities is essential for projects which involve the ex-works movement of large or heavy components or final products. Coastal locations would also be advantageous for those projects which depend on inter-Arab co-operation (plants serving non-national markets including those producing intermediates) because sea transport is likely to be cheaper than other modes for inter-regional movements.

Although technical information on the emission of pollutants by capital goods industries is not available, consideration should be given to two areas. First, given the relative scarcity of fresh water in the Arab world, pollution of water courses and supplies should be avoided either by appropriate location or by installation of pollution control equipment. Second, similar action should be taken in relation to projects located on the coasts of the Mediterranean Sea and the Arab Gulf. These have a low capacity for absorbing waste on account of their physical properties and configurations and there is international pressure from outside the Arab region to limit emissions into the Mediterranean.

3.4 Factors influencing the choice of strategic options II: production characteristics and technological considerations

3.4.1 Introductory remarks

This section focuses on other factors involved in the choice of product-process-technology options but, to the extent that development of the capital goods sector in Arab countries will involve technology transfers from industrialized countries, the discussion is also relevant to the Nationality Involvement decision.

The formulation of general principles in the product-process-technology area is formidable on account of the complex inter-relationships between demand, factor availability and input sourcing, production methods and economies of scale, technological complexity of products etc. Although these vary between capital goods industries and between individual products within an industry, there is typically a very strong link between product choice and choice of technology. Many products require a certain type or limited range of production technology and the state of technological capability limits the feasible product range.

The technological intensiveness of the capital goods sector and the sector's potential impact on technical progress in other sectors suggests that technological considerations should weigh heavily in planning for the sector's development. There is little evidence of Arab countries making efforts to select or develop technologies appropriate to their factor endowments to date. This is the direct result of the dominance of imports from industrialized countries of capital goods (and spare parts and components), the adoption of the turnkey projects, and of low ex-installation elasticities of substitution between factor inputs. These are, of course, reflections of the gap between a rapidly expanding demand for increasingly technologically complex products in the region and the technological capacity of the region.

3.4.2 Choice of product, production process and technology

The objective for new entrants and others is to maximise factor productivity by choosing an appropriate combination of production process and technology for a product in demand.

Significant economies of scale are a feature of capital goods production but it is important to reiterate that these economies derive from specializing in the production of a particular product, part or component (or very closely

related products, parts or components) and are not the consequence of a high overall production volume of a wide range of diverse products, parts or components in a single plant. Thus, economies of scale and economies of vertical disintegration are not incompatible.

Probably the most important principle in this area is therefore, the selection of heterogeneous products which possess similar production features (in product design, common inputs and manufacturing operations) for which there is a proven stable demand. Unless those Arab countries with limited technological capability take a quantum technological leap they will be severely constrained to the production of standardized or relatively standardized capital goods. The manufacture of non-standard machinery and equipment requires greater technological sophistication and flexibility in production processes and access to a wider range of parts and components; it also results in variable capacity utilization and the loss of scale economies.

This principle further implies concentration on a relatively narrow product range for standard equipment and machinery, first in order to benefit from economies of scale, and second, to avoid the different degrees of technological complexity associated with a wider product range.[7/] The principle has the important implication that production of parts and components should also concentrate on standard items. This in turn raises the potential for Arab sourcing, compared to non-standard items, because Arab countries lack the ability to produce non-standard parts and components. Thus, a strategy which concentrates on standard capital goods is more likely to permit the vertical disintegration of capital goods production between Arab countries.

The second major element in product-process-technology choice relates to the longer term development of the sector. Adherence to the first principle and its operational implications will not guarantee (even if production is not confined to pure assembly) the raising of technological capabilities because the products and processes chosen may be those which are expected to be technologically static in the foreseeable future. Indigenous capital goods producers must be able to initiate technological change and to respond to customers' changing technological requirements if they are to be a vehicle for technical progress and to be competitive with imports in the future. Thus, the long run future of the capital goods sector will not be achieved by specializing completely in those products, processes and technologies which are expected to be almost static.

On the other hand, the majority of Arab countries are unable in the short term to produce complex technology[8/] capital goods or those expected to

---

7/ For example, there is a marked difference in the technological complexity of large electricity transformers used in power generation and the lower capacity, step-down distribution units.

8/ This term refers to the technological complexity of the product itself and also the technological complexity of the production process. In general, technological production requirements escalate as product complexity increases. The capability to produce increasingly complex products is, therefore, a function of machine operating skills, management skills, product design capacity and R + D capacity.

experience significant technological change. The above suggests that a balance must be attained between those products, processes and technologies which are expected to be relatively static and those which, whilst still being in the short run capability of Arab countries, are more dynamic and will provide a sounder basis for the longer term development of the sector and its technological capability.

Experience in assembly and repair and maintenance activities provides a foundation for machine-operating skills but the up-grading of these skills requires training and retraining. Automation of production processes reduces the number of skilled machine operators but requires higher overall skill levels (for supervision, management, repair and maintenance, and for the operational activities) and a higher output level is usually needed to cover the capital outlay. Managerial skills for organizing and executing the production processes for more complex products are correspondingly higher.

3.4.3 Technology transfer agreements

Arab countries can enter capital goods production or up-grade existing technological capabilities either by appropriate allocation of domestic resources, or by securing access to foreign technology, or by some combination of the two. The greater the gap between existing and target technological levels and the shorter the period envisaged to achieve that target, the greater will be the technology transfer required. The Arab world's objective in this area should be to attain the maximum benefit from agreements at minimum opportunity cost. In order to maximise those benefits and to avoid the danger that Arab capital goods producers become locked into producing inappropriate products by inappropriate techniques, experience of technology transfer agreements suggests that particular attention should be paid to the following in negotiation agreements:

- The technology to be transferred will not soon become obsolete;
- The technology to be transferred is within the capability of the licencee;
- Access to the licenser's technology and R + D results in the future;
- Absence of restrictions on sourcing and sales, including exports:
- Assistance for the organization of production processes;
- Assistance for manpower training;
- Assistance for developing relations with sub-contractors and other suppliers.

Arab countries should rapidly develop the appropriate negotiating skills. In addition to seeking advice from other countries and international agencies, inter-Arab co-operation encompassing the exchange of country experience and the establishment of negotiating teams for particular industries is likely to be cost-effective. It is significant that the greater the technological capability of an enterprise, the stronger its negotiating position because of its ability to correctly identify technological gaps and to define its requirements.

However, for several reasons (apart from the payments to foreign manufacturers) technology transfer agreements cannot be regarded as a panacea, nor a complete substitute for the promotion of indigenous technological

capabilities. First, effective use of an agreement's provisions depends upon the technological adaptive effort of the transferee. Second, agreements which confer exclusive rights regarding production or sales are unlikely to promote a positive attitude towards innovation and greater efficiency, especially if such rights are accompanied by high levels of protection from imports. Third, the indigenous ability to ensure appropriate provisions in agreements depends on the local technological capability.

3.4.4 Product-process-technology options

In this sub-section the above options are analysed in terms of their characteristics, the preconditions for and barriers to entry, the problems which might arise after their adoption and their impact on technological upgrading in the future.

(a) Assembly

In its simplest form, assembly consists of relatively unskilled labour using simple hand or power tools to assemble completely knocked-down kits of standard equipment and machinery purchased from a foreign manufacturer. Somewhat more advanced, managerially and technologically, is the assembly of parts and components purchased from several suppliers some of which may be domestic manufacturers.

Such a technologically simple operation involves only limited technology transfers from the industrialized countries and it requires a relatively unsophisticated engineering infrastructure, comparable to that which exists for the repair and maintenance of imported capital goods. A domestic repair and maintenance capability is highly desirable because a relatively small commitment of resources to this activity may avoid the necessity of imports of replacement parts or complete units. For countries with very limited engineering skills repair and maintenance may have to be confined to the replacement of defective parts and this would be an appropriate activity for local assemblers.

Assembly is the least demanding option in terms of those indigenous inputs which are in especially short supply in Arab countries. With production confined to a narrow range of standard products economies of scale are significant. The import content of the final product is high but efficient operations should enable the producer to be competitive in export markets.

Given the premium attached to capital goods produced to the standards and specifications of industrialized countries over their domestically designed and manufactured counterparts and the relative willingness of foreign manufacturers to agree to assembly-only agreements which involve relatively little transfer of technology, assembly of standard products represents a low risk, low resource cost option for entry. However, because it is a low risk activity there is a danger that the industry will not develop beyond the soft state. Assembly should, therefore, be considered a stage in the development of the capital goods sector rather than a permanent state. During the assembly stage resources should be committed by enterprises, national governments and where appropriate, by sub-regional or Pan-Arab institutions to

the technological enhancement of the sector particularly by the development of supplier industries and the engineering infrastructure, manpower training, specialist technical services and design, research and development capabilities and to seeking the transfer of more advanced technologies from the industrialized countries.

(b) Simple technology

This option refers to the crude copying of standard imported equipment. It raises machine-building skills and, as it involves a higher local content than simple assembly, it encourages backward linkages. Crude copies would probably command a lower price than their imported equivalents because of the latter's proven performance and reliability. Experience indicates that product quality is often inferior due to low quality domestic parts and components and this has not only put downward pressure on price but has also tended to restrict sales to narrow domestic markets. In order to avoid inferior quality and for this option to be successful, indigenous suppliers and the engineering infrastructure have to be both more extensive and more technologically advanced than for simple assembly. Similarly, the capital goods manufacturers have to be managerially and technologically more advanced than assemblers. The option might appeal to those countries whose users of capital goods are severely constrained by limited capital resources.

(c) Intermediate technology

This consists of the domestic manufacture of standard machinery and equipment equivalent to imports but adapted to local resources and user requirements; the option may also be termed adaptive imitation. Compared to the two previous options it represents a technological advance being principally distinguished by the requirement of an indigenous basic design capability. Other preconditions for its adoption are either long experience in machine building or rapid skill development in this area, access to reasonably cheap machine tools and access to a wide range of engineering services. The effective market size is dependent upon user requirements. The more similar these are within a product range and within a geographical area, the greater will be the demand and hence the scope for scale economies in production. The more technologically demanding user requirements are the greater the required technological capability of the producer and the more important it is to have access to either technologically sophisticated local suppliers or world wide sourcing. The less standardized the product the more the option resembles that of complex technology and with demand being less stable the more essential are accurate assessments of the market size in relation to plants of m.e.s.

As well as being technologically more demanding than the two previous options (and therefore requiring greater technology transfers) it is also economically superior in that it represents adaption to local factor endowments and to the relative input prices facing both the capital goods sector and its customers.

Successful production of intermediate technology goods is hindered not only by the indigenous constraints mentioned above but also by the existence throughout the world of large numbers of actual and potential manufacturers of

modified standard equipment. If the national sub-regional or total Arab market is to be large in relation to the m.e.s. plant the degree of modification to standard equipment would have to be limited. Thus, the ease of imitation on the part of non-Arab producers will result in only short term monopoly profits for Arab adaptive imitators.

On account of this and the fact that relative factor prices are likely to change, this option as a state does not imply a static capital goods sector. It must be able to respond to changes in demand and to supply-side developments. To maintain its competitive position the sector, under this option, must be dynamic and hence resources must be committed to those areas (technical services, design, R + D, manpower training, etc.) which ensure that the technological gap does not widen further. Moreover, improvements in these areas enhance the prospects for successful entry into the production of complex capital goods.

(d) Complex technology

This option is only feasible for those Arab countries which have considerable experience of producing intermediate technology goods or for those which may be considered to face no serious constraints regarding financial resources, including foreign exchange. Whereas the former group would be able to embark on the production of some complex capital goods in the relatively near future if they can up-grade their existing technological capabilities, the latter would have to invest massively in those activities necessary for raising technological capability.

Demand for complex technology capital goods is less stable than for standard or modified machinery and equipment. It would be highly desirable therefore to attempt to match production plans for the complex technology capital goods industries with those for the development of the respective user industries. This would be done at national, sub-regional and Pan-Arab levels depending upon the relationship between the respective market sizes and the capacity of the m.e.s. plant. High sales volumes are essential to cover the outlays associated with the production of complex technology capital goods and thus, in the absence of a short term capability to export outside the Arab world, inter-Arab co-operation becomes more significant.

Customers' specific requirements must be incorporated into the design of complex capital goods and therefore excellence in design and R + D and close contacts with user industries are essential requirements for this option. In addition the engineering infrastructure, manpower and the specialist technical services must be of the highest calibre. Because the engineering infrastructure and potential indigenous suppliers of parts and components are far from being as technologically advanced as those in the industrialized countries, a higher proportion of tasks would have to be undertaken in-house (with consequent loss of specialization advantages and greater managerial problems), or parts and components would have to be imported. Indeed, given the nature of the developments in complex technology capital goods, there is no Arab substitute for imports of certain types of parts and components (for example, electronic and computer control equipment). Thus, this option calls for a procurement policy which is not narrowly confined to the Arab world.

Two other considerations are especially relevant to this option. First, the very nature of the option requires substantial and long term transfers of foreign technology. Second, on account of the high real resource costs involved, complex technology options will require either higher levels of protection from imports or more intense promotional policies and higher subsidies than will the other options.

3.5 Factors influencing the choice of strategic options III: Arab co-operation at sub-regional and Pan-Arab levels

This section aims to provide guidance on the selection of strategic options for the development of the capital goods sector in the Arab world insofar as those options involve some degree of inter-Arab co-operation.

3.5.1 The scope for co-operation and the potential economic benefits of co-operation

Areas in which inter-Arab co-operation might be envisaged include the following:

(a) Co-ordination of national economy-wide and sectoral plans;

(b) Co-ordination of production and trade in the capital goods sector and in forward- and backward-linked sectors;

(c) Manpower (planning, education, training and retraining, mutual recognition of qualification, pooling and international labour migration);

(d) Technology transfer negotiations with non-Arab manufacturers;

(e) Negotiations with industrialized countries (trade and commercial policy, finance, labour training abroad);

(f) Energy and water (resource surveys, project planning, trade and shared supplies);

(g) Electricity generation and distribution (standardization of systems to permit international transmission);

(h) Transport (international networks and facilities sharing);

(i) Research and development facilities;

(j) Specialist technical services;

(k) Procurement;

(l) Pollution levels and controls; and

(m) Currency exchange rates (to minimize exchange rate losses in relation to inter-Arab trade and joint projects).

The discussion concentrates on those areas which would appear to be of particular significance.

The demand for capital goods is a derived demand and therefore economy-wide plans and those for sectors directly and indirectly related to the capital goods sector will, to the extent that they are fulfilled, have a very significant bearing on the size and nature of the market for capital goods at national, sub-regional and Pan-Arab levels. Plans for the development of sectors both upstream and downstream of the capital goods sector will influence and be influenced by plans for the capital goods industries. Lack of sound and detailed plans for these related sectors will reduce the validity of planning for the capital goods sector in isolation. Plans for all sectors should therefore be integrated and be mutually consistent and feasible in terms of objectives, resources and implementation policies.

The scope for co-operation in the production and trade of capital goods arises from the economics of the industry and may take two forms. First, plants in one or a limited number of countries producing final capital goods for sub-regional or Pan-Arab markets rather than the national market. Second, the vertical disintegration of the sequential nature of capital goods production between plants located in more than one country. These developments, together with economies obtained by co-operation in fields such as manpower training, the provision of specialist technical services and R + D facilities could significantly reduce unit production costs. This in turn would permit a wider range of capital goods to be produced. Co-ordination of Arab capital goods production along these lines would require appropriate co-operation in trade and commercial relations between the Arab partners.

Given the expected role of technology transfers in the development of the Arab capital goods sector, another area of co-operation worthy of special attention is negotiations with established manufacturers in the industrialized countries. Three points can be made. First, if inter-Arab co-operation efforts in the production of capital goods and in the supply of factors and services are successful, more capital goods projects could be undertaken with available Arab resources than would be the case if the development of the sector proceeded on purely national bases. The consequent increased demand for foreign technology would increase the bargaining strength of Arab enterprises in their negotiations with manufacturers in the industrialized countries. Second, negotiators need to be knowledgeable and skilled and there are potential economies from pooling Arab expertise in this area. Third, there would be similar advantages from monitoring technology transfer and other types of agreements by fewer, more centralized sub-regional or Pan-Arab agencies compared to a larger number of individual national agencies.

3.5.2 Constraints on co-operation and problems arising from co-operation

Apart from political issues which are outside the terms of reference of the present study a number of factors may hinder inter-Arab co-operation.

Certain sub-regions, for example the Gulf Co-operation Council countries, are essentially competitive rather than complementary in economic terms. That is, countries have a comparative advantage in the same or very similar products and this limits the gains from the integration of capital goods production at least in the short run.

Second, developments in the past and existing commitments militate against co-operation. Trading and procurement channels and transport and communications systems may not be appropriately geared to meet expected inter-country movements consequent on the co-ordination of production between countries. Individual countries have collaborated with different foreign manufacturers (of both capital goods and downstream products) and the resultant purchasing of non-identical equipment and machinery reduces the size of the replacement market for individual products, both final capital goods and their constituent parts and components. Similarly, Arab enterprises may be under contract for some years ahead to obtain supplies of capital goods, parts or components from specified non-Arab sources. Thus some of the advantages of standardization have already been eroded and the benefits from standardization, scale economies and greater Arab sourcing will be confined to new projects and may take longer to materialize than has sometimes been envisaged.

Third, an important feature of a sound development plan is that it should be flexible so that policy-makers and economic agents can respond to changing circumstances. The locking together of individual national plans relating to the capital goods sector is likely to result in a slower and/or suboptimal response because the optimal response will not be the same for all partner countries.

Fourth, the operation of large industrial complexes with plants in several countries requires management of the highest calibre. Furthermore, centralized sub-regional or Arab procurement agencies dealing with both Arab and non-Arab suppliers will tend to create an undesirable wedge between capital goods producers and their customers and suppliers. Direct and open contact between these are essential if the capital goods and other sectors are to be able to respond appropriately to changes in demand and technology.

However, by far the most difficult set of problems arising out of co-operation concerns the distribution of expected benefits and losses between the participating countries. Each potential partner country would enter into co-operation agreements only if it expects to obtain greater net benefits than those expected to result from any other national policy action. The structure of production and trade consequent upon inter-Arab co-operation will only be of comparable net benefit if that structure corresponds to that which would result from adherence to the principles of comparative advantage. Departures from these principles will lead to a conflict between sub-regional or Pan-Arab interests and those of particular partner countries.

Removal of controls which hinder intra-Arab integration in production and trade (negative integration) would permit national specialization according to comparative advantage but a consequence of this might be the concentration of activities in particular countries on account of market or supply-side factors. Strategies which include joint projects serving non-national markets but located in particular countries require negative integration measures for freer intra-Arab trade and perhaps freer factor mobility. Although broadly-based measures would provide greater flexibility to deal with changing circumstances, they would also permit unplanned flows which may further concentrate production and resources in a limited number of countries. On the other hand, tighter and more narrowly-based agreements designed to prevent increasing inequality between countries would be less able to accommodate changing circumstances.

Positive integration measures would be needed to ensure either some degree of balance between countries in terms of the number and types of projects or an equitable distribution between countries of the profits and losses of jointly-financed projects located in a limited number of countries. The strategy adopted should certainly not hinder the development of existing economically efficient capital goods plants and industries irrespective of their location. Furthermore, to the extent that a strategy prescribes developments which are seriously out of line with comparative advantage, potential non-Arab foreign aid donors will be less likely to assist projects which, in their perception, would result in resource misallocation.

Finally, it is important to emphasize that inter-Arab co-operation regarding the capital goods sector should not preclude fuller integration with the wider international economy. Arab countries, individually or in concert, will not be able to supply competitively the entire range of capital goods demanded in the Arab world or all their constituent parts and components. For the capital goods sector to become a vehicle for the enhancement of productivity growth throughout the Arab world it must be able to source world-wide. Also if reductions in production costs in the future require plant output volumes higher than Arab demand then it is essential for Arab capital goods industries to be able to sell outside the Arab world.

The large market for capital goods in the Arab world provides an incentive to produce indigenous substitutes for the current high level of imports. The structure of the market indicates that there is scope for the production of a wide range of machinery and equipment both standard and non-standard. Market and supply side considerations suggest that it would be appropriate to concentrate production on relatively standard final products, parts and components and to organize this in certain cases on sub-regional or Pan-Arab bases. However, future development of the capital goods sector should be in accordance with comparative advantage and based on existing economically efficient enterprises. Plants which are expected to continue to be unefficient should be closed down thereby permitting their claim on scarce resources to be reallocated. Whereas final product manufacture typically requires large plants for economically efficient operations, economies of scale in parts and components production may be achieved in small and medium sized establishments. The development of the capital goods sector will require considerable efforts to raise technological capabilities and to increase the quantity and quality of the factor inputs required. The sector will need access to foreign technology and protection or subsidy, the extent and phasing of these being dependent upon the choice of strategic option and the target date for international competitive self-reliance.

4. POLICY FORMULATION

4.1 Basic considerations

The development of a successful capital goods sector in Arab countries depends crucially on the formulation and implementation of deliberate policies designed to bring this objective about. There are many factors which, in the absence of policy measures, would combine to ensure that Arab demands for capital goods would continue to be met overwhelmingly by imports: the significant competitive advantage enjoyed by existing producers, especially those in advanced industrial countries; economies of scale; accumulated technological knowledge and experience; established reputation and commercial links with user industries. Added to these are constraints within the Arab countries themselves: relatively small market size in many cases; shortages of essential resources, especially scientifically trained personnel and entrepreneurs; a tendency often to regard domestically produced products with disdain vis-à-vis competing imports; industrial policies which may be inconsistent with or actually inhibit the development of the capital goods sector.

The purpose of this chapter is therefore, to make specific recommendations as to policy measures to be followed. Such recommendations need, however, to be based on clearly defined policy oriented principles if they are to be consistent and coherent. Hence, some attention will be given in the next section of this chapter to formulate such a set of principles. Similarly, the identification of particular capital goods projects must also be done on the basis of logical and consistent criteria if the strategy of building a successful capital goods sector is to be other than piecemeal and ad hoc and if the danger of resource misallocation is to be minimized. Thus, the treatment of setting targets for the production of particular products will be prefaced by a consideration of the factors which ought to be taken into account in making such decisions. The adoption of a strategy and the formulation of policies represent only a beginning, albeit an important beginning. The successful implementation of such measures is also vital. In part this is a function of the political will to succeed and, given the importance of interest groups in some countries such as merchants who import, inter alia, capital goods, this cannot entirely be taken for granted. Such issues are beyond the scope of this study, however. What is of concern and is of probably crucial importance, is the need to accompany policies aimed at stimulating capital goods production with institutional changes which in many instances will be involved with eliminating constraints elsewhere in the economy. Hence, this chapter must also concern itself with proposals to bring about an appropriate institutional framework. As a final introductory remark, it is necessary to stress the importance of treating the strategy for the development of a capital goods sector within the context of overall national (or indeed regional) economic goals and also to bear in mind the desirability of maintaining trading and other relationships with the wider world.

4.2 Policy-oriented principles required for the formulation of the strategy

The number and diversity of products which could be classified as capital goods is enormous. Moreover, the inter-relationships both between these products and with other economic outputs are also very extensive. Add to

these factors the severe shortages of necessary inputs, skilled manpower, entrepreneurs, managers and technicians as well as material and financial constraints and it becomes clear that investment in capital goods projects must be based on a careful selection of priorities. This reinforces the broad conclusion of the previous chapter, that such choices, whether taken nationally or regionally, should reflect comparative advantage.

This is not to deny the possibility that infant industry protection may be necessary for a time to protect newly established Arab capital goods producers against the accumulated advantages of industrialized countries' competitors. Rather it is stating that the projects undertaken must accord with the pattern of resource endowments, existing infrastructure and labour force characteristics which are found in different countries and different regions of the Arab world. In this way the advantages of specialization and trade can be enjoyed both by developing production and exchange of capital goods co-operatively between Arab nations but also by maintaining imports from industrialized countries where the latter countries' comparative advantage is likely to remain strong (probably in products embodying very advanced technology).

Whether investment in capital goods production is undertaken by private enterprise, or directly by the state, or through a partnership involving both public and private enterprise, the role of government is fundamental. Its overall economic strategy, fiscal, monetary and trading policies must produce an environment which is conducive to the success of the sector. This has not always been the case. Tariffs whose primary objective is to raise revenue do not necessarily conform to the required pattern and industrialization policies have sometimes sacrificed domestic capital goods producers by lowering or abolishing tariffs on capital goods imports in order to hasten the development of import-substituting consumer goods industries.

This focuses attention on a pre-eminently important role for the government, that of economic planning and co-ordination. If this role is vital in the determination of national priorities, then a fortiori it applies when it comes to co-operation on a regional or wider scale. The process of planning allows explicit account to be taken of economic interdependencies between the capital goods and other sectors of activity, the demand for whose products is manifested in a derived demand for capital goods. It also allows constraints and bottlenecks to be identified before they exercise their influence and for measures to be taken to eliminate them or at least to minimize their impact. And it also reduces the likelihood that the government's own policies will be inconsistent.

It is in the initial planning stages that strategic decisions need to be taken as to which capital goods projects should be promoted to ensure maximum returns in terms of efficient resource use and dynamic contribution to industrial development. The prerequisite to this is the establishment of clear criteria.

4.3 Criteria for selecting capital goods projects

The factors which need to be taken into account in determining investment priorities can conveniently be divided into what may be termed demand oriented and supply oriented considerations. While they can be treated separately for analytical purposes, they do, of course, need to be viewed in conjunction when it comes to policy making.

Taking demand oriented factors first, the principal need is clearly to have regard to the existing economic and industrial base and to forecasts of its growth and development in future years. This should produce a careful assessment of the derived demands for capital goods. Where the needs of local industrialists have been largely met by imports of particular capital goods, the levels of and recent trends in these imports should provide a reasonable indicator of demand. Where there are significant local suppliers of capital goods, the gap between these supplies and the level of total demand provides an indication of the scope for further import substitution. To forecast demands on the part of domestic user industries there needs to be added a realistic appraisal of the potential export market for newly established capital goods products. The objective is clearly to establish those products having the greatest potential demand and hence market size.

Supply oriented factors are more numerous and more complex. Of overriding importance from the point of view of economic viability of any industry, but which applies with special force to capital goods, is the minimum efficient scale of production. If the market size identified is significantly below this level, severe cost penalties are likely to be incurred which make production uneconomic. Industries which exhibit economies of scale may be seen as candidates for regional co-operation. Another crucial determinant of success is the compatibility of an industry with the resource endowment of the country concerned as well as with the existing and feasible infrastructure. Also deserving consideration in an appraisal of investment priorities is the degree to which particular capital goods industries maximize economic linkages with other parts of the economic system. It would obviously be desirable to undertake projects which exert far reaching favourable impacts, directly or indirectly on other activities, for instance by stimulating the growth of ancillary specialist services or acting as a catalyst for technical progress in other industries. From the government's point of view, those projects which assist in the attainment of its strategic objectives, for instance in the fields of employment or science and technology are also likely to prove attractive. There is also the question of the technology gap. Where the establishment of a particular industry involves a significant advance in technological knowledge or where technology is still in the process of rapid change such a project is unlikely to succeed except perhaps in the very long run. This technology gap problem is not one which confronts only developing countries in general or Arab countries in particular. Even industrialized Western European countries and Japan recognize themselves as suffering a technological comparative disadvantage vis-à-vis the United States in some fields. On the other hand, it does not follow that Arab countries should confine themselves solely to projects embodying only relatively modest technology. An important part of their national development programme must be to foster scientific and technological advance and the acquisition of an appropriate design and engineering

capability. Partly this involves the pursuit of deliberate policies to promote research and development and to improve scientific education, which will be discussed in a separate section. But capital goods production itself can dynamically affect the extent and pace of technological advance in the economy.

Before attempting to identify particular capital goods projects which merit consideration by Arab countries, it is proposed to supplement the general principles of policy and selection criteria with a more detailed set of recommendations for government action to foster the development of a capital goods sector.

4.4 Recommendations for policies to promote capital goods production

There are many ways in which government policy and government action can create a favourable environment in which a capital goods producing sector can be nurtured and encouraged to grow. Insofar as its direct involvement through state enterprises permits it to display preference in its procurement decisions, it can ensure that orders go to domestic suppliers who can offer suitable products. It can also direct public investment towards infrastructure projects, for instance in transport facilities such as roads and docks, which eliminate bottlenecks faced by capital goods producers. Again, domestic suppliers of, for example, construction equipment, can be encouraged by involvement in a public economic development, the government can ensure that projects in agriculture and other industrial sectors are consistent with the plans being made for capital goods (and vice versa). Its influence will also be pervasive if the finance for investments derives from its own revenues or if it exercises control over the direction of investments made via the banking system or the capital markets.

A number of specific policy proposals, many of which involve institutional reform are listed as follows:

(a) Promotion of links between producers and users of capital goods, perhaps by establishing a regular forum for joint discussions. This could also serve as an information service providing firms with knowledge about specifications and sources of supply of particular equipment.

(b) Provision of specialized technical services and support for research and development, if necessary by establishing a national research institute or alternatively by subsidizing the efforts made by individual firms and encouraging the dissemination of new knowledge.

(c) Provision of training programmes in science and engineering to overcome the constraint on the availability of skilled workers. As well as establishing institutions for technical education and training, it may also be desirable to provide financial incentives for students to enrol in such courses.

(d) Establishment and promotion of national standards. Ideally this should be undertaken in harmony with other Arab countries so that variations can be minimized and economies of scale enjoyed by joint venture undertakings.

(e) Establishment of an infrastructure to promote exports of capital goods. This would involve the provision of information to domestic producers about conditions, legal requirements, customer requirements and information generally about doing business on overseas markets. It may also involve the organization of trade fairs and visiting delegations. There may also be a role in arranging the underwriting of credit risks.

(f) Measures for strengthening domestic consulting engineering expertise so as to lessen reliance on information provided by foreign equipment suppliers which may be biased in favour of their own product ranges.

(g) Establishment of an agency for negotiating and monitoring license agreements covering the transfer of technology from foreign firms. A national agency may be able to deal on more equal terms with established foreign companies and could also ensure that agreements made conformed to the national interest.

(h) Establishment of a forum for the promotion of regional and international co-operation among Arab nations. Co-ordination of capital goods production programme at the planning stage would best guarantee the avoidance of duplication of effort. It might also be possible for such a forum to organize the multinational transfer of highly skilled human resources between Arab countries on a consulting basis as a means of overcoming this critical bottleneck.

(i) Direct investment may be necessary to establish domestic ancillary support industries, for example to supply parts and components or to arrange for the servicing and repair of equipment.

The above is not an exhaustive list of policy measures. In general, government policy should aim to make good any gaps or shortcomings in institutional arrangements which, at the planning stage, are identified as potential constraints on the successful achievement of a viable capital goods sector. These policies can, however, only succeed if they are implemented in conjunction with appropriate overall economic policies and, above all, in relation to a development strategy which takes explicit account of the economic linkages between the capital goods sector and the agricultural and industrial sectors.

Having established a general policy framework and suggested criteria for identifying suitable capital goods projects, the next section suggests a range of particular projects which are likely to deserve prominence in Arab countries' attempts to develop capital goods manufacturing.

4.5 Possible projects

4.5.1 Some forecasting figures

The choice of priority projects needs to be made in the light of a careful assessment of existing economic structures and projected development in the economy as a whole. It should, therefore, be central to the planning process. It is, however, possible to identify broad categories of capital goods which at least merit further study *a priori* because of their obviously fundamental importance.

The inclusion of projects in the following list of recommendations does imply the absence of existing production facilities and expertise in the Arab world. Clearly there are many types of capital goods whose production is already established. However, there is considerable scope for up-grading the production of such goods, both in terms of the scale of output and in terms of technological complexity.

Demand projections are a critical factor in identifying projects likely to succeed. For some types of capital goods, which are tied directly to the development of a particular sector, for example oil, natural gas, or petrochemicals, the forecasting procedure is straightforward. For other types, however, which are not tied to particular activities, a more general macro-economic forecast is required. There are methodological problems in carrying out such forecasts for the Arab world as a whole. Some countries do not have sufficiently comprehensive data bases over a long enough time period to permit the use of econometric methods. Nor have many of the important economic relationships been sufficiently stable to permit econometric models to succeed. The rises in oil prices in the 1970s and early 1980s brought about significant strucutral changes, particularly, of course, in oil producing countries. Hence to some extent a judgement approach is necessary, coupled, where appropriate, with statistical analysis of economic relationships which are stable.

Past experience provides an important guide to future prospects and ideally a period of at least a decade of observations ought to be used. However, given the magnitude of the structural changes mentioned earlier occasioned by the post-1973 oil price rises, a shorter period had to be considered if the past was to give a relevant guide to the future. Hence the period 1975 to 1980 was taken. Just as oil price movements have in the past produced important changes in economic direction and in the relationship of economic variables, so uncertainty about the future course of oil prices makes forecasting the level of national income growth and hence the potential demand for capital goods hazardous. Such uncertainties will affect the scale and possibly the number of plants which are viable in Arab countries and their rate of growth of output rather than the potential *per se* for Arab production of most capital goods. It is necessary to produce a range of forecasts, therefore, giving both optimistic and pessimistic outcomes. Since there is no *a priori* way of judging the most probable outcome, a central forecast of future market size is used in the following list of projects which are considered suitable for further study.

The size of the Arab market demand for capital goods can be measured by the level of imports of each category. But not all Arab countries produce such detailed import figures and there are differences in the standard trade classification used by different Arab countries. The quality and comparability of export statistics, however, allows such estimates to be made. Hence, estimates of OECD countries' exports of capital goods by category to Arab countries, plus those of non-OECD, non-Arab countries' exports to Arab countries forms the basis for establishing past levels and current demand, together with, where feasible, information on Arab production of capital goods in the category concerned. The totals are expressed in value terms since volumetric data give generally inadequate information, for instance disguising major improvements in quality, and are in any case

frequently not available. All totals are expressed in United States dollars at 1980 exchange rates and forecasts for 1990 and 2000 are presented in terms of constant 1980 prices and exchange rates. Product classification is based on the SITC revision 1 except for those items for which it gives inadequate information. The more detailed revision 2 data were only available from 1978.

The forecasts and identification of projects which follow are largely based on studies done for AIDO by the Economist Intelligence Unit. Some projects are capable of early implementation and may thus deserve status as priority projects. Others may have to await the infratructural and institutional policy changes discussed earlier and others may require a level of technological capability or have a minimum efficient scale of production such as to make Arab countries' invoivement more difficult in the short term. Estimates of current or forecast market size are not necessarily synonymous with recommended Arab production facilities. New capital goods producers will probably be best advised to specialize in those types of a product which correspond to major demand patterns and technical capability in the short run, leaving imports to supply the more esoteric and technically more advanced variants.

4.5.2 Projects at product level

(a) Engineering infrastructure

This is a term for a range of processes which supply inputs to manufacturers, not only of capital goods, but also producers of intermediate and final consumer goods. Included in the category are: ferrous and non-ferrous foundry work; forging; general steel fabrication; specialized machining; pressing. The components supplied by such engineering services will contribute varying amounts to value added in different capital goods trades with an average, perhaps, of 20-25 per cent for the types of capital goods industries likely to be developed in Arab countries. The fundamental nature of this infrastructure and the obvious linkages with practically all other sectors of the economy argue for an immediate priority to be given to this category.

There are a number of other capital goods whose manufacturing processes are closely allied with the above and which should also be included in this category. Table 9 gives some indications of market size for specific types of product.

Generally speaking, given the importance of industries such as petrochemicals and programmes such as desalination projects and irrigation works there is considerable scope throughout the Arab world for all kinds of containers and vessels, pipelines and metal structures to be produced so that an increasing proportion of Arab demand is satisfied by Arab production.

(b) Textile machinery

The production of textile machinery is as diverse as are the processes involved in textile production itself. International competition in fabrics and clothing is fierce and the scope for manufacture of textile machinery

Table 9. Projected demand of products related to capital goods, 1980-1990 and 2000 (in million $US)

	1980	1990	2000
Iron and steel structures	3,300	5,950	9,450
Aluminium structures	340	1,270	2,120
Metal tanks, vats, reservoirs, etc.	130	290	450
Foundry moulding boxes and moulds	110	370	880
Stainless steel vessels for dairy farm equipment	25	65	160

depends in part on the success of Arab producers in meeting such competition. It is likely that Arab markets would support the broad categories of machinery shown in table 10.

Table 10. Projected demand of textile machinery, 1980-1990 and 2000 (in millions $US)

	1980	1990	2000
Spinning machines	200	330	450
Auxiliary equipment for weaving and knitting	110	160	250
Bleaching, washing and dressing machines	260	390	630
Calendering and rolling machines	20	40	60

(c) Construction equipment

Arab demand for construction equipment amounted to about 16 per cent of total world demand in 1982, the absolute value of Arab purchases being above $US 2.2 billion. With demand projected to grow to around $US 3 billion in 1990 and $US 3.5 billion by 2000 there are substantial opportunities for local Arab producers. The involvement of this industry with infrastructure development and the linkages with the engineering services mentioned above add to the attractions of investment in this category of products. Initial production should possibly concentrate on crawler dozers, crawler loaders, wheeled loaders and dump trucks. The world market for heavy construction equipment is dominated by relatively few large scale firms which operate on an international scale and it is likely that Arab ventures will have the best chance of success if they are carried out in association with multinational companies.

(d) Pumps and valves

There are strong linkages with important industries and infrastructure projects throughout the Arab world which makes the manufacture of pumps and valves a candidate for high priority status. Low temperature and low pressure uses occur in irrigation schemes, larger sizes may be required for water supply and sewage services and very large sizes are likely to find uses in sea water desalination plants. The oil, gas and petrochemical industries represent a further source of demand and there are also applications in mining and in the operation of power stations, for instance for the circulation of cooling water. The value of total market demand for pumps, estimated at $US 500 million in 1980, is expected to double to $US 1,009 millions in 2000. The value of pumps and valves combined is expected to grow from $US 955 millions in 1980, to $US 1,358 millions in 1990 and to $US 1,927 millions by 2000. The manufacture of pumps and valves requires the use of high quality castings in iron, bronze and aluminium and hence will benefit from investment in the engineering infrastructure.

(e) Agricultural tractors

Arab demand for tractors is expected to grow from 31,000 units in 1980, to 43,500 in 1990 and 61,500 in 2000. There are already a number of plants producing tractors in Arab countries but, with the exception of Algeria (where 80 per cent of the content is local), these tend to be assembly operations. An increase in the proportion of Arab added value is possible, however, and should come about through the development of the engineering infrastructure and, especially, if diesel engines are produced by Arab countries. This latter facility is important, not only to increase the value added in the supply of original equipment but also because the replacement market for engines and engine components represents an important proportion of tractor manufacturers' business.

(f) Agricultural equipment and agricultural hand tools

There is scope for large scale production of a range of agricultural equipment of the type which is used in conjunction with tractors. The products include ploughs, seeders, planters, fertilizer distributors, harrows, hoes and scarifiers. In addition there is harvesting machinery (other than combines), presses and winnowing machines, all of which are suitable for early development. As expertise develops, combines and other more complex equipment can be added to the product range. Combined Arab demand for these products amounted to $US 395 million in 1980, is expected to be $US 550 million in 1990 and should reach $US 930 million by 2000. In addition, agricultural hand tools and agricultural sprayers could also be produced by enterprises manufacturing agricultural equipment, although they may be equally suitable products for enterprises specializing in hand tools in general and enterprises making spraying machinery. There are obvious economic linkages with tractor manufacture and engineering infrastructure and the development of the agricultural sector is bound to feature prominently in national development plans.

(g) Fork lift trucks

Fork lift truck manufacture is a relatively straightforward process of component assembly. The international market is competitive, however, and production on a large scale is likely to be needed for success and this in turn argues for the limitation of production to a narrow range of standard trucks. Arab demand for fork lift trucks is likely to grow quickly, from $US 470 million in 1980 to $US 1,600 million by 1990 and approaching $US 4,000 million by 2000. Given their wide range of economic applications and the scope for progressively raising local content as engineering infrastructure and the supply of local components and diesel engines is built up, there is a case for regarding fork lift trucks as a priority project.

(h) Mineral crushing and sorting machinery, pneumatic elevators and conveyor belts.

Demand for machinery to crush, grind and sort minerals is derived from activities such as cement production, mineral extraction industries and construction. Total Arab demand for the range of products used for crushing, grinding, sorting, screening and agglomerating was about $US 300 million in 1980 (with crushers and grinders accounting for most demand) and is expected to reach $US 530 million in 1990 and $US 810 million in 2000. There is in addition a large market for replacement parts. Total Arab demand for elevators and conveyors was estimated at $US 25 million in 1980 and should reach $US 35 million and $US 50 million, respectively, in 1990 and 2000. There is an obvious linkage with engineering infrastructure activities including castings, beltings, bearings, gears and drive units and, especially for mobile units, diesel engines and gear boxes. Given the heavy nature of the products, access to good roads and harbour facilities will be vital.

(i) Cranes, pully tackles, hoists and winches

The manufacture of cranes is essentially a steel fabrication activity, with engines, cables and parts being bought in, increasingly from Arab suppliers, to the extent to which such ancillary industries are developed. Demand for lifting, loading and handling machinery (of which cranes form a part) was some $US 385 million in 1980 and is expected to rise to $US 570 million in 1990 and almost $US 900 million by 2000. Arab demand for pully tackles, hoists and winches should grow from about $US 40 million in 1980 to $US 50 million by 1990 and $US 65 million by 2000.

(j) Non-domestic refrigerators

The major use for non-domestic refrigerators is for shop display. More ambitious versions, which could be developed later as experience is built up, are used for cold-store equipment. The heart of a refrigerator is a gas compressor. It may be advisable to import the machinery in the early phases and concentrate on building the housings. Arab demand for the full range of refrigeration and cold-store equipment was $US 90 million in 1980 and should grow to $US 165 million in 1990 and $US 260 million in 2000.

(k) Hand tools

Arab production already exists, but there is scope for extending the range of products made and possibly for greater specialization between plants in terms of different technologies employed. Arab demand amounted in 1980 to about $US 210 million and this should rise to approximately $US 425 million in 1990 and $US 680 million in 2000 (including agricultural tools).

(l) Containers for road and rail transport

Containers for transport require straightforward manufacturing techniques and there is scope for several centres of production in the Arab world. Demand for such products was $US 20 million in 1980 and this is expected to amount up to $US 40 million in 1990 and some $US 65 million in 2000.

(m) Electric insulators and other electrical fittings

Electrical insulators used in power transmission provide a convenient means of diversification for enterprises already engaged in the manufacture of quality ceramic products, such as bathroom furniture. From a level of demand of about $US 65 million in 1980, total Arab demand is likely to rise to $US 160 million by 1990 and to $US 280 million by the end of the century. There is a further market for other electrical insulating fittings which could amount to $US 160 million by 2000 and electrical carbons used in rotary electrical equipment provide another opportunity for Arab involvement in the supply of ancillary equipment which is bound to grow in line with electrification programmes and the more wide-spread use of industrial and domestic electrical apparatus.

(n) Steam generating boilers and pressure vessels for petrochemicals and oil refineries

Boiler manufacture involves the fabrication of large pressure vessels. An integrated fabrication plant would also be capable of manufacturing the following types of equipment: shell and tube heat exchangers, distillation columns, catalytic reactor vessels, gas scrubbers, filters and separators, furnaces and pressure vessels for oil refining and petrochemical processes, etc. There are clear and very strong linkages with some of the most important industrial activities in the Arab world, including oil refining and natural gas processing and petrochemicals industries. There is in addition an important application to the electric power generation programme. Hence the market for such products in Arab countries is large and is likely to grow quite rapidly. In 1980 the steam generating boiler market alone was worth $US 340 million with an associated demand for ancillary equipment amounting to $US 65 million. By 2000 the total values are likely to be $US 1,465 million for boilers and $US 612 million for ancillary boiler equipment. The total demand for boilers and all types of heavy fabrications was $US 601.9 million in 1980 and is estimated to rise to $US 1,176.5 million in 1990 and $US 1,881.5 million in 2000.

Heavy fabrications are therefore clearly justified as potential capital goods ventures in view of the size of the Arab market. However, extremely high skill levels are involved, as well as significant design capabilities.

Relatively few engineering companies in the industrialized world are capable of meeting the required performance, quality and safety standards. A high level of engineering infrastructure is also required and so is a capability to install the fabrications shop itself. The bulky nature of the products of this industry requires good road transport facilities and harbours, as well as heavy lifting equipment. Given the relative complex technology and the need for such a high level of engineering and other infrastructure, it is likely that expertise in this type of capital goods will best be established step by step, with the more straightforward types of boilers and vessels being fabricated initially, building up to those types with more stringent quality and safety requirements later.

(o) Machine tools

The total Arab demand for metal-working machine tools and parts amounted to some $US 345 million in 1980 and is expected to rise to nearly $US 790 million in 1990 and to about $US 1,600 million in 2000. About 90 per cent of this total demand is accounted for by the following classifications of machine tools: lathes, milling and reaming, drilling and boring, sawing, sharpening, trimming, grinding, bending, forming, folding and flattening, shearing, punching, notching, other presses, other machine tools, machine tool parts. A significant proportion of the demand for tools in these categories is likely to be for the more standard, basic machine tools, which could clearly form the basis for the development of a machine tool industry in Arab countries. The more sophisticated tools could more economically be imported initially. All machine tool manufacturing requires a good engineering infrastructure as well as high skill levels and a strong capability for research and development. Initially, however, licensing agreements with established manufacturers should be concluded to ensure that Arab facilities have access to up to date and competitive technology. Machine tool production is increasingly concentrating on the output of numerically controlled and computer numerically controlled machines. However, machine tool producers themselves tend to buy in the necessary electronic equipment from specialist suppliers.

(p) Diesel engines

There are several kinds of diesel engines, each requiring a different manufacturing technology. Since total Arab demand relates mainly to one category, it is in this field that it would be logical to concentrate Arab production. This category relates to high speed diesel engines of 1,200 to 4,000 rpm, whose uses are mainly in highway vehicles, farm tractors, earth-moving equipment and fork-lift trucks. This list of applications makes it clear that there are substantial linkages with other capital goods projects which are being recommended, including the engineering infrastructure. The size of the current and potential market is difficult to estimate directly, since many engines are supplied as part of the complete vehicle or plant in which they provide the power unit. Thus, demand must be inferred from estimates of the demand for these (with allowances made for the fact that some vehicles use petrol engines as well as diesel and some fork lift trucks are electrically powered). Tentative estimates of the grand total of forecast demand for diesel engines in the Arab world are 173,000 units in 1980 and 283,000 and 443,000 units in 1990 and 2000 respectively (including those for

use with irrigation pumps and compressors). There already exists some manufacturing capacity, notably in Algeria and Egypt, which should logically form the nucleus of an expanded Arab role in diesel engine production. Skill levels necessary for the production of diesel engines suggest the need for a continuing association with an international producer. Other categories of diesel engines should continue to be imported for the time being. These categories include medium speed engines (500 to 1,200 rpm) which are used for marine, locomotive and stationary applications and low speed diesels (less than 500 rpm) used for large marine and stationary applications.

(q) Electrical transformers

Electrical transformers are devices for stepping up or down output voltages in relation to the corresponding voltage input to the unit. They range in size and capacity from very small units with applications to consumer electrical goods to massive power station installations. This discussion is concerned with the oil-cooled transformers suitable for the distribution of electrical power. The bulk of Arab demand is for transformers up to 6MVA (millions of volt-amps) in size (98 per cent of volume demand in AIDO countries) and initial production facilities should be concentrated on the manufacture of this range, going on later, perhaps, to produce the larger units of up to 200 MVA. The larger sizes would require an ambitious technological advancement and this reinforces the recommendation to gain experience with smaller types first. The manufacture of these will require the existence of a good engineering infrastructure. Licensing of technology agreements would need to be concluded with established manufacturers of transformers and it is also likely that expatriate engineering expertise will be needed to supplement local skills in the early stages of the project.

(r) Telephone switching equipment

Arab countries' demand for telephone switching equipment is forecast to rise from 250,000 lines in 1980 to 780,000 lines in 1990 and to over two million lines in 2000. This massive growth coincides with a technology shift away from electro-mechanical to electronic exchanges and provides Arab countries with an opportunity, not only to invest in the most advanced systems, but also to lay the foundations for the closely related electronics and computing industries. Entry into telephone switching equipment requires large scale investment and skilled labour and will inevitably involve licensing technology from an established manufacturer, who should ideally also provide training programmes for personnel. A minimum scale of production to exploit economies of scale is likely to imply a plant size of 500,000 lines a year which, given estimated demand, should justify up to four separate plants in the Arab world.

(s) Machinery for cleaning and filling containers

Bottling plants are a major component of this category. These involve the installation of machinery for performing a wide range of processes including de-crating or de-palletising glass containers, cleaning, inspection, filling, sealing, processing (e.g. heat treatment), labelling and packing. Increasing use is being made of automation, not only to reduce costs, but also to facilitate the co-ordination of line speeds which the diversity of processes

calls for. Total Arab demand for cleaning and filling machinery is likely to rise from some $US 319 million in 1980 to $US 850 million in 1990 and some $US 2 billion in the year 2000. The main categories of demand are likely to be for the bottling of liquids, including aerated drinks and UHT milk. Canning of vegetables and vegetable oils is also likely to be significant. Equipment is usually built to a specific order and will constitute a significant demand for many of the products of the engineering infrastructure including steel (with stainless steel having important applications in food processing operations), motors, pumps, valves, bearings, couplings and whole ranges of other mechanical components. On the demand side the economic linkages with food processing are clear and the demand for liquids, especially soft drinks, is likely to remain very strong.

(t) Interchangeable tools for hand and machine tools

This industry could well develop in association with an Arab machine tools sector, since the bulk of the applications is likely to be for machine tools. Demand in the Arab world is estimated to rise from $US 170 million in 1980 to $US 450 million in 1990 and to about $US 1 billion by 2000. The products of this industry range from the fairly simple items such as drill bits to more complex types. As well as the linkage with the machine tool industry, there are also links with the engineering infrastructure, for example in the need for high quality steels.

(u) Plant construction contracting

The final project to be considered has fundamental linkages with virtually all the others which have been recommended for consideration. Industrialization in general, including the establishment of capital goods assembly and manufacturing plants, is likely to give rise to a multi-billion dollar a year demand for construction. Some will inevitably involve the importation of structural components and machinery and in some cases this will take the form of complete turn-key projects. Nonetheless there should remain a substantial amount of on-site construction work and a proportion of this at least should be won by Arab construction contractors, possibly in association with international firms where specialized technical skills are involved. Arab construction contractors should ensure that a high proportion of material and equipment is supplied by the local engineering infrastructure. Given the all-pervading nature of construction contracting, it should be a high priority to establish such expertise.

It should be noted, as a concluding comment, that the above list of projects is not necessarily exhaustive and does not preclude the identification of other schemes which may be brought forward in the course of national or regional planning exercises.

5. RECOMMENDATIONS FOR JOINT VENTURE CAPITAL GOODS PROJECTS IN ARAB CO'NTRIES[9/]

5.1 Importance of joint venture capital goods projects

Previous chapters have identified in broad terms the major criteria which should help to determine capital goods projects which Arab countries could establish with a high probability of success. A number of specific categories of capital goods have also been suggested as being suitable for further study. This chapter takes the process further in the following ways:

(a) By providing forecasts of the size of the supply-demand gaps which are likely to exist in 1990 for a wide range of products categorized in terms of the SITC code;

(b) By providing, both in quantitive and qualitative terms, indicators of other relevant criteria, including minimum efficient scale, technological complexity and the extent of economic linkages;

(c) By providing also information about input requirements; and

(d) By suggesting which countries or regions of the Arab world are the most appropriate locations for production facilities for particular products, both in terms of existing expertise and resource base.

The Arab countries accounted for approximately 10 per cent of the world demand for capital goods in 1980, valued at $US 44 billion. Of this total, approximately 95 per cent was imported. The advantages of increasing capital goods production in the Arab world are not limited to the substantial savings of foreign exchange, which are very important to those Arab countries without large export earnings from oil. Expanded production of capital goods will increase the technological capabilities of the region thus reducing technological dependence. In addition, local design will lead to the production of capital goods suitable to the resource endowments and product requirements of the Arab countries. Joint Arab projects for the production of capital goods will lead to increased intra-Arab trade and co-operation, increasing the self-reliance of the Arab region.

5.2 The supply-demand gaps

The first step in identifying capital goods for production in the Arab countries is to examine the gap between Arab demand and Arab production for each category of capital goods. Forecasts of these gaps in 1990, based on a previous UNIDO study, are presented in table A.1 in the annex. The categories are presented in descending order, with the largest supply-demand gap presented first.

The largest supply-demand gaps tend to be for what might be described as heavy equipment. The production of much of this equipment is technically only moderately complex, so that there is no technological reason why

---

9/ The chapter is almost wholly based on UNIDO, Recommendations for Joint Venture Capital Goods Projects for the Arab Countries, April 1984.

substantially more of this type of capital goods could not be produced in Arab countries in the immediate future. Capital goods whose production requires more complex technology, such as computer controlled machine tools or gas turbines, should not be neglected in Arab planning; however, the manufacture of these products must await the build-up of the appropriate technological knowledge.

The capital goods listed in table A.1 also differ according to the extent to which Arab production takes place. While for many of these products the amount of local production is small relative to imports, local production is still significant because it provides familiarity with the technology of production which can serve as a basis for dramatically expanded production. There is significant local production, in this sense, for items A-1, 2, 7, 8, 10 and 12; while local production is not significant for items A-3, 4, 5, 9 and 11. The lack of significant local production does not preclude Arab production, but does suggest co-operation (licensing or joint ventures) with existing producers.

5.3 Other criteria for project selection

The identification of large supply-demand gaps is the first step in selecting capital goods for production in the Arab countries. The second step is to compare these gaps with the minimum efficient scale of production. For this purpose, the four and five digit SITC categories are too broad, in most cases including products whose production is normally carried out in different facilities. Thus, specific products (or product groups which can be manufactured in the same facility) have been identified within each of the major categories listed in table A.1. The forecast supply-demand gaps for these products are compared with the minimum efficient scale of production in the first two columns of table A.2.[10/] The ratio of the forecast supply-demand gap to minimum efficient scale can be taken to represent the approximate number of additional production facilities required to satisfy the total demand of all Arab countries. As can be seen from table A.3 this ratio varies a great deal from one product to another, from a low of 1.0 for industrial air conditioning and refrigeration units and oil-well casing to a high of 500 for bench drills, saws, etc. (simple machine tools). Numbers as low as 1.0 imply a single production facility serving all Arab countries and a commitment from all Arab countries to purchase the Arab product. Values which range from 2.0 to 5.0 imply regional production centres, while values of 9.0 or more suggest that production could be located in each major country on a scale designed primarily to satisfy local needs. These latter products could be left to local initiatives. There are, however, reasons why joint ventures might be desirable. First, they might be desirable to stimulate production of capital goods in cases where unfamiliar markets or technology have hindered the growth of production in Arab countries. For example, the supply-demand gap to m.e.s. ratio is very large for simple machine tools (A-10-1), yet in

---

10/ The forecast supply-demand gaps and minimum efficient scale of production for specific products are largely based on technical information contained in volume 5 of the EIU/AIDO report, The Development of the Capital Goods Sector in the Arab Countries.

1980 the Arab countries supplied less than 10 per cent of their own needs. For this product, joint ventures may be necessary in order to establish Arab production. Second, the establishment of larger production units may increase bargaining power where licensing of advanced technology is necessary as, for example, in the production of textile machinery.

Once a comparison of the forecast supply-demand gap and minimum efficient scale of production has been made, other features of production of specific capital goods must be examined. Table A.2 provides a broad summary of these features of production, which include technological complexity, potential forward and backward linkages, input requirements and gains from high volume production or specialization.

Technological complexity may rule out the immediate production of some capital goods in Arab countries, for example: gas turbines (A-14); steam turbines (A-15-1); textile machinery (A-11); oil well casing (B-1-3); and telephone switching equipment (B-3-1). These products should not be ignored by the Arab countries, for to do so would imply acceptance of a continued technological lag. However, in selecting projects for these products, consideration must be given to the additional costs imposed by the need to develop the required technological skills.

Large backward linkages associated with the production of a product may be created if there are reasonable possibilities of developing the supporting industries and engineering infrastructure. For example, the production of buses, lorries and trucks (A-1); construction equipment (A-3); fork lift trucks (A-4-1); mineral crushing, grinding and sorting equipment (A-5-1); and agricultural tractors (A-12) all require diesel engines. Since Arab countries currently manufacture and assemble diesel engines (A-8-1), the co-ordinated development of the production of these products could feature diesel engine plants which supply engines to several other capital goods industries. Exactly the same argument could be made for backward linkages to casting or to steel production. On the other hand, the production of gas and steam turbines (A-14 and A-15-1) requires alloys which cannot be produced in Arab countries without very substantial upgrading of technological capabilities. These backward linkages, which imply dependence on imported materials, are a negative aspect of the production of these items.

The particular input requirements may be important factors in determining the location of a project or in selecting projects. For example, production of capital goods which require a large labour input should be located in countries with large populations, while those for which transportation is an important input should be located where there are good links to major ports. Depending upon goals, the amount of employment or value added per unit of investment may be important determinants of the desirability of the manufacture of particular products. Figures illustrating these matters are presented in table A.3. For example, if employment creation is a major goal then products with large employment-investment ratios, such as power transformers (A-2-1); construction equipment (A-3); fork lift trucks (A-4-1), diesel engines (A-8-1); industrial air conditioning and refrigeration units (A-9-1); agricultural tractors (A-12); and heavy fabrications (B-1-1), become attractive. If value-added per unit of investment is a desirable feature, then products such as construction equipment (A-3); power transformers (A-2-1); and heavy fabrications (B-1-1) become attractive.

5.4 Identification of specific projects

The general criteria discussed above must be applied on a product by product basis in order to evaluate projects for the production of specific capital goods. A number of such applications are listed below.[11/]

A-1 - Buses, lorries and trucks

The forecast supply-demand gap is large relative to minimum efficient scale, suggesting that production could be developed on the basis of existing and new local initiatives. However, the large backward linkages associated with this production as well as the large size of the supply-demand gap imply that it can provide stimulation to infrastructure and be an important source of demand for other capital goods, such as diesel engines. Thus, in countries where local production has not been developed on a sufficient scale, joint ventures may be desirable. Modern production methods are relatively capital intensive and have relatively low labour requirements.

A-2-1 - Power transformers, 0.025 - 6 MVA

There appears to be sufficient demand for four or five regional centres of production. Production may be carried out either by highly automated labour saving methods, or by more labour intensive methods. The former are probably more appropriate to the Gulf region, while the latter may be more appropriate in highly populated countries, such as Egypt, Syria and Algeria. There are backward linkages to steel and copper metal fabrication which suggest location near sources or potential sources (copper in the Arabian peninsula) of these products. In the Mahgreb, existing facilities may provide the basis for expanded production.

A-3-1 - Hydraulic excavators and loader backhoes

There appears to be scope for one or two joint projects. Production is labour intensive and benefits greatly from specialization. Demand is heavier in the GCC and Fertile Crescent regions suggesting the location of at least one of the projects in this area, perhaps in Iraq. Existing production facilities in Algeria may provide the basis for expanded production in North Africa.

A-3-2 - Crawler dozers and loaders, wheeled loaders

The forecast demand-supply gap suggests that up to seven regional centres may be appropriate, with at least one centre in each region. Specialization of these centres in specific products is desirable. Production requires large inputs of semi-skilled labour so that location in populous countries is appropriate. However, the concentration of demand in the Arab East suggests production in countries of this region.

11/ The country groups referred to are Arab West: the Mahgreb (Algeria, Libya, Morocco, Tunisia) and Nile Valley (Egypt, Sudan); Arab East: the Fertile Crescent (Iraq, Jordan, Syria); and Arabian peninsula: (Saudi Arabia and other GCC countries).

A-3-3 - Mobile cranes

Up to seven regional centres are indicated. The production of these items requires larger inputs of both capital and labour than the previous categories of construction equipment. Existing facilities in Algeria may provide the basis for expanded production in the Mahgreb, while new facilities should be constructed in the Nile, Fertile Crescent and GCC regions.

A-3-4 - Motor graders, scrapers and off-highway dump trucks

The supply-demand gap suggests that four regional centres are appropriate, one in each of the Arab regions. There are large gains from product specialization, so that each regional centre may specialize in a restricted line of products. Labour requirements are large. As with the previous categories of construction equipment, there are substantial backward linkages to diesel engines and castings, suggesting that development of these facilities should be co-ordinated.

A-3-5 - Portable compressors for construction

Although these products are technically different from the preceding categories of construction equipment, their production is similar in most respects. There are backward linkages to casting and diesel engines and production requires a substantial input of semi-skilled labour. Unlike the other categories gains from specialization are small, except in production of the required castings. The supply-demand gap suggests scope for three joint projects, at least one of which should be located in the Arab East region.

A-4-1 - Fork lift trucks

The supply-demand gap suggests six to nine production centres. Relatively large centres producing a variety of trucks (alternative A) use more labour and are more appropriate for countries with larger populations, while smaller more specialized and more automated centres (alternative B) are appropriate for less populous areas, such as the GCC. There is no significant local production upon which to base expansion. Backward linkages to electric motors may reinforce similar linkages from pumps.

A-5-1 - Mineral crushing, grinding and sorting equipment

There appears to be scope for nine production centres. The fact that there is no local Arab production indicates that joint projects are needed. The technology of production is relatively simple and benefits of specialization are small. There is a heavy demand on transportation, so that production should be located with good access to ports. There is a concentration of demand in the Arab East, implying that some production units should be located in the Fertile Crescent and the Arabian peninsula.

A-7-1 - Low pressure and temperature pumps and valves

There is some local production, but it accounted for only 5 per cent of demand in 1980. Thus, it appears that joint projects are needed. The establishment of a smaller number of large production units would facilitate

the creation of a product design and development capability, as well as making negotiation for licensing easier. Production demands relatively large amounts of skilled labour, as well as a large investment in an automated foundry. Aside from the foundry, there are no substantial gains from high volume but there may be gains from product specialization. There are significant backward linkages to motors. The major locational concern is the availability of skilled labour.

A-8-1 - High speed diesel engines

The supply-demand gap suggests that three joint projects are needed. This product has important forward linkages with trucks (A-1); construction equipment (A-2); fork lift trucks (A-4-1); mineral crushing, grinding and sorting equipment (A-5-1); and agricultural tractors (A-12). The location and timing of the joint projects should be co-ordinated with the development of these products. Production is relatively labour intensive and there are substantial gains from specialization and high volume, implying that each plant should specialize in engines of a particular type. There is sufficient local production in both Egypt and Algeria to serve as the basis for expanded production. At least one plant should be located in the Arab East, specializing in engines for construction equipment and mineral crushing, sorting and grinding equipment.

A-9-1 - Industrial air conditioning and refrigeration units

The supply-demand gap indicates scope for one joint project. Production is only moderately complex and requires large inputs of semi-skilled labour, making location in a country with a large population desirable. Good access to ports is also desirable. There is local experience of producing the household counterparts of these items. These factors imply location in Egypt, Iraq or one of the Mahgreb countries.

A-10-1 - Bench drills, saws, bench grinders, simple shearing and planing machines

There are low gains from high volume which, together with a large supply-demand gap, lead to scope for 500 new production units. These could easily be left for local initiatives. However, the small amount of local production of machine tools (6 per cent of demand in 1980) suggests that joint ventures may be desirable. Technology is relatively simple, but requires a large input of skilled labour. Demands on transportation are low.

A-10-2 - Lathes, milling and boring machines; planing and shaping machines

As in the production of simpler machine tools there is scope for a large number (at least one hundred) of relatively small production units. The technology is moderately complex and requires large inputs of skilled labour and transportation. There is already local production in Algeria, Egypt, Morocco and Tunisia, which could serve as a basis for expansion in these countries. There are substantial gains from specialization, suggesting plants designed to produce specific products. There are also benefits from combining a number of small production units into larger units; in particular, in developing design capability and in negotiating for new technology.

A-10-3 - Numerically controlled (NC) and computer numerically controlled (CNC) Lathes

Production of these machines is technically complex and current Arab demand may not be sufficient to justify the large production volume which is necessary for efficiency. However, these products should not be neglected and efforts to build up the required technical expertise should begin now. A research centre should be established in order to begin developing technological knowledge. This research centre could be associated with a university established in computer and mechanical engineering, perhaps in Saudi Arabia or Egypt. The long-term goal of the research centre would be to develop sufficient design capability so that Arab production could begin.

A-11 - Spinning machines and looms

For these products over forty production units could be justified by the supply-demand gap, suggesting that these products be left to local initiatives. However, the fact that there is no Arab production (probably due to the technological complexity of the product) implies that joint ventures are desirable. Again, grouping together a number of small producing units, each specializing in different products, has the advantages of increasing design capability and improving bargaining power in the licensing of advanced technology. These products may be designed with local needs and resource availabilities in mind. The world-wide trend in textile equipment is the introduction of highly automated, labour-saving machinery. However, the major Arab textile producers (Egypt, Morocco, Syria, Algeria and Iraq) all have large populations, suggesting that labour intensive equipment may be appropriate for this industry. Thus, these products should be tailored to the resource endowments of the Arab textile producers. The manufacture of these products is complex with large inputs of capital, skilled labour and transportation. There are also substantial backward linkages to casting.

A-11-2 - Dyeing and finishing machinery

The supply-demand gap suggests that over 100 production units may be appropriate. In other respects production is similar to that of looms and finishing machines, with the exception that demands on labour are only moderate, being primarily for welders.

A-12 - Agricultural tractors

For this product the indication of scope for five new production units based on the supply-demand gap is somewhat misleading. There is already substantial assembly capacity in the Arab countries concentrated in North Africa. What is needed, however, is increased local content. This can best be achieved through local initiatives. There is scope for new plants in the Arab East as well as expansion of selected North African plants. Production features large gains from specialization, large backward linkages and large demands for semi-skilled labour and transportation.

A-14 and A-15-1 - Gas and steam turbines

These projects are technologically complex so that immediate production in Arab countries is not feasible. However, the supply demand gaps are large and efforts to acquire the required technical knowledge and skills should

begin. A research centre should be established, certainly in conjunction with a centre for oil well casing and perhaps in conjunction with a centre for machine tools, whose goal would be to develop both design and production capability.

B-1-1 and B-1-2 - Heavy fabrications and large high pressure boilers

The supply-demand gaps suggest the establishment of four to five new joint projects for the manufacture of each of these products. Production requires good access to ports and may also require large inputs of semi-skilled labour.

B-1-3 - Oil well casing

One joint project is indicated for this product. Production is technologically complex and also requires large inputs of skilled labour and transportation. The support of a local research centre is desirable. The hign transportation input suggests production close to (or in) the using countries. Algeria, Iraq and Saudi Arabia are possible locations.

B-3-1 - Telephone switching equipment

The supply-demand gap suggests that one new joint project should be installed by 1990. The product is technically complex and would benefit from an associated research centre. There are substantial gains from high volume production and substantial demands on skilled labour. Demands on transportation are low. The production of this equipment could provide the basis for the development of electronic control production which would provide inputs into the production of other capital goods.

Although each capital good may have special characteristics which affect its production, there are general features which are relevant to all capital goods. In the above discussions, consideration has been given to the size of demand relative to minimum efficient scale, to the technological complexity of the product, to potential forward and backward linkages, to gains from high volume or specialization and to input requirements. These features have been used to indicate the desirability and location of specific joint projects.

Table A.1. Forecast supply-demand gaps for capital goods in the Arab countries, 1990

	Product	SITC Code	Supply-Demand Gap, million US $ at 1980 Prices
A.	Four and Five Digit SITC's		
1.	Buses, Lorries, Trucks	732.2,3,4	8487
2.	Power Transforming Machinery	722.1	3510
3.	Construction, Mining Machinery	718.4	3106
4.	Mechanical Handling Equipment	719.8	2927
5.	Mineral Processing Machinery	718.51	2263
6.	Insulated Wire and Cable	723.1	2093
7.	Pumps and Centrifuges	719.2	2061
8.	Other Internal Combustion Engines	711.5	1457
9.	Air Conditioning Machinery	719.2	1242
10.	Machine Tools	715.1	865
11.	Textile Machinery	717.1	860
12.	Tractors	712.5	826
13.	Refrigerating Equipment	719.15	796
14.	Gas Turbines	711.6	658
15.	Steam Engines	711.1,2,3	657
16.	Measuring Apparatus	729.5	641
17.	Powered Tools, Other	719.5	531
18.	Aircraft Engines	711.4	391
19.	Industrial Furnaces, Strokers, Ovens	719.13,14	372
20.	Batteries and Accumulators	729.1	347
21.	Food Processing Machinery	718.3	332
22.	Electric Furnaces	729.92	303
23.	Agricultural Machinery for Cultivating Soil	712.1,2	285
24.	Printing Machinery	718.2	265

Table A.1. Continued

	Product	SITC Code	Supply-Demand Gap, million US $ at 1980 Prices
25.	Packaging Machinery	719.62	251
26.	Spraying, Vending, Other Machinery	719.61,64, 65,66	220
27.	Sewing Machinery	717.3	137
28.	Pulp and Paper Machinery	718.1	133
29.	Ball, Roller Bearings	719.7	119
30.	Freight: Railway, Tramway Cars	731.6	110
31.	Statistical Machinery	714.3	108
B.	Two and Three Digit SITC's, not represented above		
1.	Metal Manufactures	69	6865
2.	Ships and Boats	735	4393
3.	Telecommunications Apparatus	725	3968
4.	Aircraft	734	2563
5.	Medical Apparatus	726	140

Notes:
1. The forecast supply-demand gaps are based on forecasts contained in Arab Demand for Capital Goods in the Short, Medium and Long-Term, UNIDO, August 1983. The "low-trend" forecasts, which are the most conservative, were used.
2. The products are listed in descending order of supply-demand gap.
3. All four and five digit capital goods for which the forecast supply-demand gap exceeds 100 million US $ are included.

Table A.2. Comparisons of selected capital goods relevant to the Arab countries

Product[1]	Arab Supply[2] Demand Gap, 1990 (million US$ at 1980 prices)	Minimum[3] Efficient Scale (million US$ at 1980 prices)	Technological Complexity of Production	Potential Forward/Backward Linkages (bought-in/sales)	Input Requirements: Capital (investment/ sales ratio)	Input Requirements: Labour (labour/sales ratio) semi-skilled	Input Requirements: Labour (labour/sales ratio) skilled	Input Requirements: Work in Process	Input Requirements: Energy	Input Requirements: Transportation	Gains from High Volume Specialization
A-1 Buses, Lorries and Trucks	8437	500	moderate	Backward to diesel engines tires, electrical components (0.85)	3.5	9 large	moderate	large	moderate	low	large
A-2 Power Transforming Machinery	3510										
1. Power Transformers, 0.25 - 6 MVA	135	23	moderate/ complex	Backward to steel, copper metal fabrication	0.5	22 moderate	large	moderate	low	moderate	moderate
A-3 Construction, Mining Equipment	3106										
1. Hydraulic Excavators and loader Backhoes	353	190	moderate	large backward	0.25	9 large	moderate	large	moderate	moderate	large
2. Crawler Dozers and Loaders, Wheeled Loaders	1453	200	moderate	large backward (0.5)	0.2	8 large	moderate	large	moderate	moderate	large
3. Mobile Cranes	747	100	moderate	large backward (0.5)	0.4	14 large	moderate	large	moderate	moderate	large

Table A.2. Continued

Product[1]	Arab Supply[2] Demand Gap, 1990 (million US$ at 1980 prices)	Minimum[3] Efficient Scale (million US$ at 1980 prices)	Technological Complexity of Production	Potential Forward/Backward Linkages (bought-in/sales)	Input Requirements: Capital (investment/ sales ratio)	Input Requirements: Labour (labour/sales ratio) semi-skilled	Input Requirements: Labour (labour/sales ratio) skilled	Input Requirements: Work in Process	Input Requirements: Energy	Input Requirements: Transportation	Gains from High Volume, Specialization
4. Motor Graders, Scrapers and Off-Highway Dump Trucks	316	70	moderate	large backward (0.5)	0.6	17 large	moderate	large	moderate	moderate	large
5. Portable Compressors for Construction	154	50	moderate	Backward to castings, diesel engines	0.75	12 large	moderate	moderate	moderate	moderate	large in casting, otherwise small
A-4 Mechanical Handling Equipment	2927										
1. Fork Lift Trucks[4]	945	a) 150 b) 100	simple moderate	Backward	a) 0.5 b) 0.45	20 large 8 large	moderate moderate	moderate moderate	low low	large large	large large
A-5 Mineral Processing Machinery	2263										
1. Mineral Crushing, Grinding and Sorting Equipment	419	45	simple	Backward to castings, diesel engines, etc.	0.9	22 large	small	large	low	large	small
A-6 Insulated Wire and Cable	2093										
A-7 Pumps and Centrifuges	2061										
1. Low Pressure and Temperature Pumps and Valves 4-19 inch bore	620	20	moderate	backward to motors, actuators (0.4)	3.0	25 small	large	moderate	moderate	moderate	small (except foundry)

Table A.2. Continued

Product[1]	Arab Supply[2] Demand Gap, 1990 (million US$ at 1980 prices)	Minimum[3] Efficient Scale (million US$ at 1980 prices)	Technological Complexity of Production	Potential Forward/Backward Linkages (bought-in/sales)	Input Requirements: Capital (investment/ sales ratio)	Input Requirements: Labour (labour/sales ratio) semi-skilled	Input Requirements: Labour (labour/sales ratio) skilled	Input Requirements: Work in Process	Input Requirements: Energy	Input Requirements: Transportation	Gains from High Volume, Specialization
A-8 Other Internal Combustion Engines	1547										
1. High Speed (1200-4000 rpm) Diesel Engines	400	120	moderate	large forward and backward	0.25	moderate	21 moderate	moderate	moderate	moderate	moderate to large
A-9 Air Conditioning Machinery	1242										
1. Industrial Air Conditioning and Refrigeration Units	200	200	moderate	substantial backward to casting	.6	large	25 moderate	moderate	moderate	moderate	large in casting, otherwise moderate
A-10 Machine Tools	865										
1. Bench drills, saws, bench grinders, simple shearing and planing machines	449	0.9	simple	low, backward	2.2	moderate	55 high	moderate	low	low	low
2. Lathes, milling and boring machines; planing and shaping machines	340	2.9	moderate	high backward (.33)	2.0	moderate	38 high	high	low	low	large
3. Numerically Controlled and Computer Numerically Controlled Lathes	--	--	complex	high backward	--	moderate	-- high	high	low	low	large

Table A.2. Continued

Product	Arab Supply[2] Demand Gap, 1990 (million US$ at 1980 prices)	Minimum[3] Efficient Scale (million US$ at 1980 prices)	Technological Complexity of Production	Potential Forward/Backward Linkages (bought-in/sales)	Input Requirements: Capital (investment/sales ratio)	Input Requirements: Labour (labour/sales ratio) semi-skilled	Input Requirements: Labour (labour/sales ratio) skilled	Work in Process	Energy	Transportation	Gains from High Volume, Specialization
A-11 Textile Machinery	860										
1. Spinning machines, looms	415	10	complex	backward to casting, infrastructure (.35)	2.3	moderate 30	large	large	small	large	large
2. Dyeing and Finishing Machinery	390	3	complex	backward to casting (.37)	2.3	moderate 43	moderate (welding)	large	small	large	large
A-12 Agricultural Tractors	826	155	moderate	large backward (.45)	.5	large 26	moderate	large	moderate	large	large
A-14 Gas Turbines	658		very complex	large demands on infrastructure		moderate	large	large	moderate	large	large
A-15 Steam Engines	657										
1. Steam Turbines			complex	large demands on infrastructure		moderate	large	large	moderate	large	large
B-1 Manufactures of Metal	6865										
1. Heavy Fabrications	370.5	79	moderate	backward to steel	.73	moderate 24	moderate	large	moderate	large	moderate
2. Large High Pressure Boilers and Heavy Fabrications[5]	670.5	144	moderate	backward to steel	1.16	moderate 21	moderate	large	moderate	large	moderate

Table A.2. Continued

Product[1]	Arab Supply[2] Demand Gap, 1990 (million US$ at 1980 prices)	Minimum[3] Efficient Scale (million US$ at 1980 prices)	Technological Complexity of Production	Potential Forward/Backward Linkages (bought-in/sales)	Input Requirements: Capital (investment/ sales ratio)	Labour (labour/sales ratio) semi skilled	Labour (labour/sales ratio) skilled	Work in Process	Energy	Transportation	Gains from High Volume Specialization
3. Well Casing	515	500	complex	backward to steel	1.2	moderate	1.5 large	large	moderate	large	large
8-3 Telecommunications Apparatus	3968										
1. Telephone Switching Equipment	273	175	complex	backward to components, parts	.86	moderate	11 large	small	small	small	large

Notes: (1) Product designations correspond to those in Table 1. Sub-categories refer to specific components or groups of components whose manufacture can be carried out in the same plant.

(2) For broad product categories these are taken from Table 1. For sub-categories, these figures are based on the AIDO/EIU study, The Development of the Capital Goods Sector in the Arab Countries, Volume 5: Monographs on Potential Joint Projects.

(3) These numbers refer to one plant. Most of the technical information in this table is based on the AIDO/EIU study.

(4) Alternative a) refers to a relatively large plant producing a number of possible sizes while alternative b) refers to a specialized, automated plant producing 2-3 ton lift trucks.

(5) The data refers to a combined heavy fabrication and boiler plant with a boiler output of $86 million (1980 prices).

Table A.3 Characteristics of production of selected capital goods

Product		Ratio of Supply-Demand Gap to Minimum Efficient Scale	Ratio of Employment (Man-years) to Investment (millions of US dollars at 1980 prices)	Ratio of Annual Value-Added to Investment
A-1.	Buses, Lorries and Trucks	17.0	2.6	--
A-2-1.	Power Transformers 0.25-6 MVA	5.4	44	1.9
A-3-1.	Hydraulic Excavations and Loader Backhoes	1.9	36	2.0
A-3-2.	Crawler Dozers and Loaders, Wheeled Loaders	7.3	40	2.5
A-3-3.	Mobil Cranes	7.3	35	1.1
A-3-4.	Motor Graders, Scrapers and Off-Highway Dump Trucks	4.5	28	0.8
A-3-5.	Portable Compressors for Construction	3.1	16	0.6
A-4-1.	Fork Lift a)	6.3	40	1.0
	Trucks b)	9.4	18	--
A-5-1.	Mineral Crushing, Grinding and Sorting Equipment	9.3	24	0.5

Table A.3. Continued

	Product	Ratio of Supply-Demand Gap to Minimum Efficient Scale	Ratio of Employment (Man-years) to Investment (millions of US dollars at 1980 prices)	Ratio of Annual Value-Added to Investment
A-6.	Insulated Wire and Cable	--	--	--
A-7-1.	Low Pressure and Temperature Pumps and Valves	31	8.3	0.2
A-8-1.	High Speed (1200-4000 rpm) Diesel Engines	3.3	84	1.0
A-9-1.	Industrial Air Conditioning and Refrigeration Units	1.0	42	0.6
A-10-1.	Bench drills, saws, bench grinders, simple shearing and planing machines	499	25	0.3
A-10-2.	Lathes, milling and boring machines, planing and shaping machines	117	19	0.3
A-11-1.	Spinning machines, looms	41.5	9	--
A-11-2.	Dyeing and Finishing Machinery	130	19	--
A-12.	Agricultural Tractors	5.3	50	0.9
B-1-1.	Heavy Fabrications	4.7	33	1.3
B-1-2.	Large High Pressure Boilers and Heavy Fabrications	4.7	18	0.7

Table A.3. Continued

Product		Ratio of Supply-Demand Gap to Minimum Efficient Scale	Ratio of Employment (Man-years) to Investment (millions of US dollars at 1980 prices)	Ratio of Annual Value-Added to Investment
B-1-3.	Oil Well Casing	1.0	1.3	0.5
B-3-1.	Telephone Switching Equipment	1.6	13	0.7

Notes: Numbers in the first two columns are based on Volume 5 of the EIU/AIDO study, while the value-added/investment ratios are taken from the project summaries in the AIDO recommendations.

BIBLIOGRAPHY

Main documents used in preparation of the study:

Arab Industrial Developament Organization (AIDO), Identification of Capital Goods Projects for Further Study (Interim Discussion Paper prepared for AIDO), February 1983.

Arab Industrial Investment Co. (AIIC), Interlinkages: Automotive, Agriculture and Construction Machinery Industries, (Draft prepared for Experts' Group Meeting, Identification of Projects for Regional Co-operation in Capital Goods and Heavy Engineering Industries, Vienna, June 1981).

Economist Intelligence Unit, The Development of the Capital Goods Sector in the Arab Countries, Volume 5, Monographs on Potential Joint Projects, (Draft Report prepared for The Arab Industrial Development Organization, May 1983).

United Nations Conference on Trade and Development (UNCTAD), The Capital Goods Sector in Developing Countries: Technology Issues and Policy Options, 1985.

United Nations Economic and Social Council, United Nations Economic Commission for Western Asia, Regional Co-operation in Development of Capital Goods and Engineering Industries in ECWA, (prepared by Joint ECWA/UNIDO Industry Division for the Second Consultation Meeting on the Capital Goods Industry and Energy-Related Technology and Equipment, Sweden, June) May 1985.

UNIDO, Arab Demand for Capital Goods in the Short-, Medium- and Long-Term, Sectoral Working Paper Series, No.18, March 1984.

UNIDO, Arab Trade in Capital Goods, Sectoral Studies Series, No.10, December 1983.

UNIDO, Capital Goods in Perspective: Definition, Importance and Analysis of Factors Affecting Demand with Special Reference to Arab Countries, Sectoral Working Paper Series, No.11, December 1983.

UNIDO, Data on Installed and Planned Production Capacities, Consumption, Imports and Exports of Manufacturing Industries and Electricity in Arab Countries, May 1984.

UNIDO, Energy and Industry (with special reference to the Arab Countries), (Prepared for the Second Arab Energy Conference, Doha, Qatar, March 1982), May 1982.

UNIDO, Long-Term Prospects of Industrial Development in Iraq, Volume II (Prepared jointly by the Secretariat of UNIDO and ECWA for the Fifth Industrial Development Conference for Arab States, Algiers, Algeria), January 1980.

UNIDO, Recommendations for Joint Venture Capital Goods Projects for Arab Countries, (Prepared by Econometric Research Ltd.), April 1984.

UNIDO, The Resource Base for Industrialization in the Gulf Co-operation Council Countries: A Framework for Co-operation, December 1983.

SOMMAIRE

L'objectif principal de cette étude est de formuler des options stratégiques et des mesures politiques susceptibles de promouvoir le développement des industries de biens d'équipement en pays arabes.

Après une introduction, le chapître 2 est consacré d'abord à une analyse de la croissance du secteur des biens d'équipement durant les quinze dernières années et les caractéristiques qui ont marqué jusqu'à présent cette industrie. Puis il considère la part que joua l'industrie des biens d'équipement dans cette région pour y satisfaire à la demande du même secteur. Le chapître 3 identifie les options stratégiques se rapportant au développement des biens d'équipement et qui pourraient le mieux s'adapter aux divers niveaux, national, sous-régional et régional (monde arabe). La formulation de ces politiques spécifiques fait l'objet d'un quatrième chapître.

Enfin, le chapître 5 apporte des suggestions sur les lieux les plus appropriés des pays arabes où la production de marchés spécifiques pourraient être entreprise grâce à des projets de coopération en association dans le secteur des biens d'équipement.

EXTRACTO

El principal objectivo del presente estudio es formular opciones estratégicas y políticas designadas para el continuo desarrollo de la industria de bienes de capital en los países Arabes.

Siguiendo la Introducción, el capítulo 2 revisa el crecimiento del sector de bienes de capital en los últimos 15 años y discute las características de la industria existente y su contribución para cubrir la demanda de bienes de capital en la región. El capítulo 3 identifica aquellas opciones estratégicas que conciernan al sector y las cuales pueden ser adoptadas a nivel nacional - subregional o regional, a través de políticas específicas, que son objeto de análisis en el capítulo 4.

Finalmente, el capítulo 5 presenta sugerencias en torno a la localización más apropiada dentro de los países, de industrias de bienes de capital específicas destinadas a satisfacer los mercados nacionales y regionales a través de projectos de empresas conjuntas.

For the guidance of our publications programme in order to assist in our publication activities, we would appreciate your completing the questionnaire below and returning it to UNIDO, Studies and Research Division, Sectoral Studies Branch, D2073, P.O. Box 300, A-1400 Vienna, Austria

---

Q U E S T I O N N A I R E

Strategies and policies for the development of the capital goods sector in the Arab world

		(please check appropriate box) yes	no
(1)	Were the data contained in the study useful?	/_/	/_/
(2)	Was the analysis sound?	/_/	/_/
(3)	Was the information provided new?	/_/	/_/
(4)	Did you agree with the conclusion?	/_/	/_/
(5)	Did you find the recommendations sound?	/_/	/_/
(6)	Were the format and style easy to read?	/_/	/_/
(7)	Do you wish to be put on our documents mailing list?	/_/	/_/
		If yes, please specify subjects of interest	
(8)	Do you wish to receive the latest list of documents prepared by the Sectoral Studies Branch?	/_/	/_/
(9)	Any other comments?		

Name:
(in capitals) .....

Institution:
(please give full address) .....

Date: .....