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1. The first part of the text discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice to ensure transparency and accountability. This is particularly crucial for businesses operating in highly regulated industries where compliance is a top priority.

2. The second part of the text focuses on the role of technology in streamlining financial processes. It highlights how modern accounting software can automate repetitive tasks, reduce the risk of human error, and provide real-time insights into a company's financial health. This not only saves time but also allows management to make more informed decisions based on up-to-date data.

3. The third part of the text addresses the importance of regular financial reviews and audits. It explains that periodic audits help identify potential issues, such as discrepancies or fraud, before they become major problems. Additionally, these reviews provide an opportunity to assess the effectiveness of current financial controls and make necessary adjustments to improve efficiency and accuracy.

4. The final part of the text discusses the importance of clear communication and collaboration between different departments. It notes that financial success often depends on the ability of various teams to work together, share information, and align their goals. Regular meetings and open lines of communication are essential for ensuring that everyone is on the same page and working towards the same objectives.

RESTRICTED

DP/D/SER.D/45  
18 May 1978  
English *red*

07064

# CAPITAL GOODS (PHASE II)

DP/MEX/72/014

MEXICO

TERMINAL REPORT

Prepared for the Government of Mexico by the  
United Nations Industrial Development Organization,  
executing agency for the  
United Nations Development Programme



United Nations Industrial Development Organization

United Nations Development Programme

CAPITAL GOODS (PHASE II)

DP/MEX/72/014

MEXICO

Project findings and recommendations

Prepared for the Government of Mexico  
by the United Nations Industrial Development Organization,  
executing agency for the United Nations Development Programme

Based on the work of R. K. D. N. Singh, project manager

United Nations Industrial Development Organization  
Vienna, 1976

### Explanatory notes

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

The monetary unit in Mexico is the Mexican dollar (\$Mex). During the period covered by the report (September 1973 - March 1976), the value of the \$Mex in relation to the United States dollar was \$US 1 = \$Mex 12.50. Note: In the body of the text the abbreviation Ps is used instead of \$Mex.

Besides the common abbreviations, symbols and terms, the following have been used in this report:

BTN	Brussels Tariff Nomenclature
ISIC	International Standard Industrial Classification
LAFTA	Latin American Free Trade Association

The following abbreviations of organizations in Mexico are used:

CFE	Comisión Federal de Electricidad
FANAMHER	Fabrica Nacional de Máquinas-Herramientas
FODICIC	Fondo para Desarrollo de Industria de Bienes de Capital
FOGAIN	Fondo de Garantía y Fomento a la Industria Mediana y Pequeña
FOMEX	Export Development Fund
FOMIN	Fondo Nacional de Fomento Industrial
FONEI	Fondo Nacional de Equipamiento Industrial
IEM	Industria Eléctrica de México
NAFINSA	Nacional Financiera S.A.
PEMEX	Petróleos Mexicanos

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While certain editorial corrections have been made on this report, it has not been edited in conformity to United Nations style.

CONTENTS

<u>Chapter</u>		<u>Page</u>
	SUMMARY . . . . .	5
	INTRODUCTION . . . . .	7
I.	BACKGROUND AND OBJECTIVES . . . . .	11
II.	PROJECT ACTIVITIES AND METHODOLOGY . . . . .	22
III.	DEMAND AND IMPORT PROJECTIONS FOR CAPITAL GOODS IN MEXICO DURING 1976-1980 AND 1981-1985 . . . . .	33
IV.	POSSIBILITIES FOR MANUFACTURING HEAVY ELECTRICAL EQUIPMENT IN MEXICO . . . . .	54
V.	POSSIBILITIES FOR MANUFACTURING MECHANICAL EQUIPMENT (COMMON-USE ITEMS) IN MEXICO . . . . .	74
VI.	POSSIBILITIES FOR MANUFACTURING MECHANICAL EQUIPMENT IN MEXICO FOR SPECIFIC INDUSTRIES . . . . .	95
VII.	GENERAL APPRAISAL OF PROJECT APPROACH AND ACTIVITIES . . . . .	109
VIII.	POLICY ASPECTS OF CAPITAL GOODS MANUFACTURE IN MEXICO . . . . .	116

Annex

List of project personnel . . . . .	135
-------------------------------------	-----

List of schedules

Chapter I

I.	Capital-goods identified in phase I-B as having adequate manufacturing potential in Mexico . . . . .	19
----	---	----

Chapter III

I.	Projected capital-goods imports distributed among 15 industrial sectors - 1970-1974 . . . . .	49
II.	Projected capital-goods imports distributed among 15 industrial sectors - 1976-1980 . . . . .	50
III.	Projected capital-goods imports distributed among 15 industrial sectors - 1981-1985 . . . . .	51
IV.	Summary of capital-goods import projections according to 38 equipment categories . . . . .	52

Chapter V

I.	List of Mexican companies having experience/interest in expanded machine-tool production . . . . .	94
----	---	----

Tables

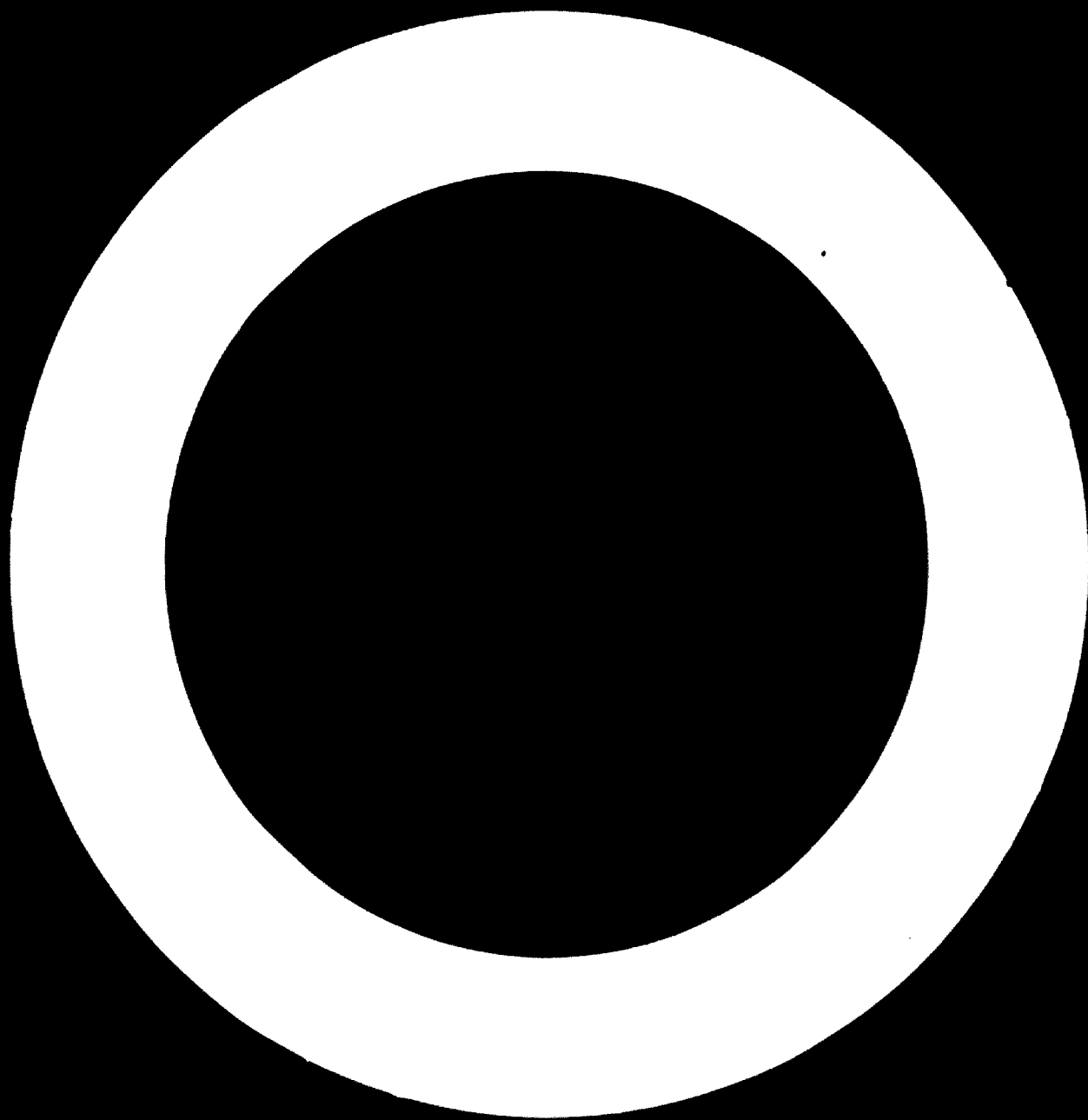
I.	Growth rates projected for 15 principal machinery-consuming production sectors .....	35
II.	Projected distribution of imports among 15 principal machinery-consuming production sectors .....	39
III.	Import projections for principal machinery groups and products (4 and 5 digits) .....	40
IV.	Growth of installed capacity for electricity generation ....	54
V.	Projected installed capacity (CFE) up to 1982 .....	55
VI.	Projected imports 1976-1980 and 1981-1985 of electrical equipment .....	56
VII.	Product mix of proposed transformer plant .....	58
VIII.	Demand for high-voltage circuit breakers ( <u>Demanda de interruptores de potencia</u> ) .....	61
IX.	Domestic markets for motors and generators in Mexico .....	64
X.	Projected additional investment in electrical equipment manufacture .....	72
XI.	Projected new capital investment for mechanical equipment of common use .....	92
XII.	Present iron and steel production in Mexico .....	98
XIII.	Total proposed capital investment (specific industrial sectors) .....	108
XIV.	Projected additional capital investment in proposed capital goods projects .....	113

SUMMARY

This is the report of the Project Manager for the project "Capital Goods Industry" (DP/MEX/72/014). For the project Nacional Financiera S.A. (NAFINSA), the development bank of Mexico, with the assistance of the United Nations Development Programme (UNDP) and the United Nations Industrial Development Organization (UNIDO), is systematically examining potentials for the growth of the capital goods industry sector. In the first phase (I-A and I-B), from November 1971 to April 1973, a team of UNIDO experts was assigned to NAFINSA to conduct basic economic and technical studies on the long-term demand for various capital goods and to analyse present capacities and the possibility for expansion of existing industries with a view to identifying and formulating industrial projects. In the present phase (II), which began in September 1973 and will continue to March 1977, the projects that have been identified and the programme of expansion are being examined in greater detail as to their economic and technological feasibility as well as to the pre-conditions for their implementation. For this phase a team consisting of an adviser on industrial policies (Project Manager), an industrial project planner (industrial engineer) and an industrial project evaluator (industrial economist) have been assigned to NAFINSA together with short-term experts and consulting firms.

The report covers the work of the Project Manager from September 1973 to the end of his assignment in March 1976. In it he gives a detailed account of the project to date and a general appraisal of its approach and activities.





## INTRODUCTION

1.1 This is the report of the Project Manager for the project "Capital Goods Industry" (DF/MEX/72/014). The report covers the work of the consultant during phase II of the project from April 1973 to March 1976.

1.2 The project was initiated by Nacional Financiera S.A. (NAFINSA), the industrial development bank of Mexico, in conjunction with the United Nations Industrial Development Organization (UNIDO). During phase I (I-A and I-B), from November 1971 to April 1973, a detailed study was carried out on projections of internal demand up to 1980 for various capital goods and on the possibilities for a revision of existing facilities for their manufacture. According to this evaluation, some groups of capital goods were identified with an adequate potential for manufacture in Mexico. It was then considered that the national production of most of this machinery could be exported gradually to Latin American countries and to North America. One of the main criteria for identifying and selecting the machinery was the possibility for its manufacture at internationally competitive costs.

1.3 On completion of phase I, preliminary meetings were held with national and foreign manufacturing companies interested in participating in machine manufacturing projects in Mexico. Following a conference on investment promotion, held at Vienna in October 1973, several manufacturing firms expressed interest in participating with money investments or technology in the Mexican projects.

1.4 The main objectives of the present phase II of the project, which was approved by the UNDP and UNIDO on 28 August 1973 and which has been extended to March 1977, are:

- (a) Preparation of feasibility studies for the specific projects identified in phase I;
- (b) Recommendations for industrial policy and other measures required to implement an expansion programme;
- (c) Recommendations for financing, technical licences etc. relating to specific projects;
- (d) Evaluation of specific projects;
- (e) Assistance for the preparation of technology licence contracts, capital participation etc. for specific projects;
- (f) Legal assistance for investment promotion of specific projects.

1.5 UNIDO has collaborated by supplying 4 experts, including the Project Manager; 12 experts for limited assignments in specific fields : such as machine tools, foundry, gears and forging, diesel machines, heavy electrical equipment etc. and the services of a specialized consultant firm to elaborate a feasibility study for the manufacture of equipment for the textile industry.

1.6 The contribution of the UNDP through December 1975 was \$539,897. The contribution of the Government of Mexico was approximately \$Mex 5 million.

1.7 According to the job description, the Project Manager was expected:

- (a) To lead and co-ordinate the work of the other members of the team and to present the findings of the team in comprehensive reports;
- (b) To plan and co-ordinate the various phases of the project;
- (c) To formulate, on the basis of the above-listed tasks, industrial projects and to elaborate specific recommendations for licensing technology and financing the projects;
- (d) To advise on the promotion of investments and to assist in the negotiations with foreign and domestic industrialists;
- (e) To review the present legal, economic, financial and foreign trade policies and instruments which affect the development of the manufacturing industry and in particular of the capital goods sector;
- (f) To prepare general guidelines and to elaborate specific proposals for appropriate policy measures for the development of identified growth industries of the capital goods sector within the framework of over-all industrial growth. Particular emphasis should be placed on measures for export promotion and for increasing the efficiency of existing industries;
- (g) To prepare proposals for policy measures and incentives which would facilitate the transfer of technology and the building up of a research and development base required for the growth of selected capital goods industries;
- (h) To organize training of counterpart personnel in these tasks.

1.8 At the time of the approval of phase II of the project (August 1973), only the Project Manager was working on the project on behalf of UNIDO; the two other UNIDO experts took up their assignments in December 1973. Owing to the considerable time it took to recruit a number of short-term technical experts specialising in different fields of capital goods manufacture, phase II of the project effectively began only in March 1974.

1.9 The final report of the Project Manager for the period from March 1972 to April 1973 was incorporated in the phase I-B report of the project. The present report, while it is the final report of the Project Manager for the remaining period to March 1976, also covers the activities of the project for the period from September 1973 to March 1976. Most of the experts,

including the Project Manager, completed their assignments by March 1976 and only one expert was expected to continue in the project up to May 1976. In view of the present "freeze" in UNDP programmes, new recruitment by UNDP is likely to be delayed. Consequently, this was thought an appropriate time to review the past activities of this major project and to take stock in defining the next stage of the project up to March 1977.

1.10 The role of the UNIDO Project Manager has inevitably extended to all aspects, functions and activities of the project in so far as the UNIDO group of experts is concerned; this final report therefore appropriately covers all such activities.

#### Structure of the report

2.1 The present report is intended to present the co-ordinated findings and recommendations of the UNIDO experts and particularly those of the Project Manager for the above period. It is necessary to emphasize, however, that the views and findings are those of the Project Manager and do not necessarily reflect the views of UNIDO or Nacional Financiera.

2.2 In dealing with the various machinery sub-sectors, this report has naturally relied heavily on the techno-economic pre-investment studies prepared by the various short-term UNIDO technical experts associated with the project during phase II. The conclusions and findings in this report are not, however, necessarily the same as those contained in the specific techno-economic studies and the Project Manager alone accepts responsibility for these recommendations. The chapter relating to projections of demand and imports follows by and large the report of the UNIDO domestic market analyst. The UNIDO group of experts associated with this project functioned as a well-knit and co-ordinated team. This report has sought to represent its views as a whole.

2.3 Since a number of machine-building projects are in various stages of negotiation, the names of companies have not been used, except where expansion proposals are involved. The avoidance of names, particularly the names of potential technology-suppliers, may detract from the report to some extent but is considered appropriate in the interest of preserving the confidentiality of such negotiations.

2.4 The following are brief summaries of chapters I-VI:

Chapter I - Background and objectives

The background of activities during the earlier phase I of the project are discussed in this chapter, together with the specific objectives set for the present phase (phase II).

Chapter II - Project activities and methodology

Certain specific activities of the project are discussed in this chapter, namely, preparation of techno-economic pre-investment studies, investment promotion activities, negotiations relating to specific projects, and techno-economic evaluation of specific projects and proposals.

Chapter III - Demand and import projections for capital goods in Mexico during 1976-1980 and 1981-1985

The earlier demand and import projections for 1976-1980 are brought up to date and estimates of demand and imports of capital goods as a whole and for specific groups and categories are projected for the period 1981-1985.

Chapter IV - Possibilities for manufacturing heavy electrical equipment in Mexico

This chapter reviews the requirements and possibilities of manufacture in Mexico of various categories of heavy electrical equipment. These include transformers, circuit breakers, electric motors and generators, porcelain insulators and hydro turbines and power boilers. The various investment propositions under consideration are briefly discussed. Projected additional investment recommended for this machine-building sector amounts to \$Mex 810 million for a number of specific and defined projects.

Chapter V - Possibilities for manufacturing mechanical equipment (common-use items) in Mexico

This chapter concerns the requirements and possibilities of manufacture of mechanical equipment in Mexico in common use in various sectors. Such equipment includes machine tools, steam turbines, pumps, centrifuges and compressors, diesel engines, medium and heavy castings (3-15 tons) and gears and speed changers etc. Projected additional investment recommended for this machinery sector is about \$Mex 868 million.

Chapter VI - Possibilities for manufacturing mechanical equipment in Mexico for specific industries

This chapter covers the requirements and manufacturing possibilities of mechanical equipment for specific industrial sectors such as textiles, iron and steel, chemicals and petrochemicals and other specific industrial sectors. For some sectors, further techno-economic studies would be necessary. Projected additional investment is estimated at \$Mex 1,333 million for the specific sectors studied in detail so far.

## I. BACKGROUND AND OBJECTIVES

### Background:

3.1 During the ~~earlier~~ Phase I of the project (Nov. 1971 - April 1973), the principal objectives were (a) general analysis of existing capital goods manufacture in Mexico, (b) the preparation of detailed projections of internal demand for principal capital-goods branches & products, (c) assessment of domestic manufacturing capacity in the major machinery subsectors, and (d) identification of specific machinery groups & products for which there appeared to be adequate potential for domestic manufacture. Broad policy recommendations for the future development of this sector were also required to be made.

3.2 The definition of capital-goods adopted was that this sector "comprised mechanical (non-electrical) & electrical equipment & major parts & components thereof, utilised as machinery and production equipment in the principal production branches". Capital-goods used in the transport sector were specifically excluded from the study & equipment & auxiliary equipment (tools, wirings & fittings) etc were also not covered. It was considered that, though this definition would not, by any means, be exhaustive, it would nevertheless highlight the principal machinery products & groups which were likely to constitute the major production & technological gaps in the Mexican economy over the next few years. The study was oriented primarily to the demand & needs of the domestic economy, on the broad assumption that capital goods production for exports would initially have to be based on a strong home market.

3.3 The general review of the Mexican industrial growth pattern in the capital goods sector in the Phase I-B study emphasised the fact that, though industrial growth in Mexico had taken place at a fairly rapid pace (over 6.5% during 1940-70), production in the capital goods sector (including transport equipment) had been comparatively very low, constituting less than 2% in the late 1960's. Investible resources have been channelled largely in the consumer goods sector & the industrial policy package, till recent years, was not particularly oriented towards stimulation & encouragement of domestic machinery production except by way of import substitution of relatively unsophisticated machinery products in various subsectors. Nevertheless, the growing size of the domestic market had resulted in the domestic production of a wide range

of machinery products & about 80 large & medium enterprises were principally engaged in the manufacture of capital goods items. Production in these units was largely geared to the domestic market, though some of these enterprises had developed export capability in recent years, both for final products & for major components & supplies.

3.4 Projections of demand & imports for the period 1976-1980 were derived through a fairly elaborate exercise of determination of growth projections in the principal machinery consuming sectors & application of machinery co-efficients for each such sector. The methodology adopted was to project the growth of the principal machinery consuming sectors such as electricity production and distribution, agriculture, construction, mining, iron and steel, chemicals and petrochemicals, pulp and paper, cement, textiles and others. Thereafter, a further broad co-efficient was applied to each of these principal machine-consuming sectors in respect of the major machinery items utilised per unit of investment. At the same time, projections were made of domestic manufacturing capacity for specific machinery groups and products together with projected expansion of such enterprises. These projections were made from official data regarding existing production, census figures, data collected in the course of plant visits and data obtained from enterprises themselves as to their production and expansion programmes. While the field survey was not exhaustive, it was fairly comprehensive and the projections of domestic production capacity are likely to be fairly realistic. The demand projections and the projections of domestic production highlighted the production gap for capital goods during 1976-1980 which would necessarily have to be covered by imports. The figures were further cross-checked by direct extrapolation of past imports of machinery to projected imports during 1976-80. As a result of these studies in 1972-3, the projected demand for capital goods (at 1967 prices) & for the period 1976-80 was estimated to be Ps 174,000 million pesos. Since projections of domestic production capacity during the period indicated a figure of Ps 91,000 million, this would leave a likely gap of Ps 83,000 million (at 1967 prices) for this period. The subsectors where projected imports were likely to be the highest were (a) electrical machines & equipment viz electrical generators & motors, transformers & circuit breakers, insulating items & control equipment, the total of which it ems came to 11.65 thousand million pesos (b) power-generation equipment, other than electrical machines, (c) various common use machinery products such as machine tools, pumps, compressors & centrifuges, heating & cooling equipment & other machinery & machinery parts & accessories, the imports of which were estimated at over 31 thousand million pesos & (d) machinery & equipment for specific

industries such as textiles, steel, mining, paper & pulp, chemicals sugar & other specific industries, the total of which came to 21.7 thousand million pesos, & of which the most important branch was considered to be textile equipment, with projected imports of 8.05 thousand million pesos.

3.4 On the basis of the projections of demand & imports, on the one hand & domestic machinery production on the other, a number of capital goods branches were identified, in the course of the earlier Phase I-B of the study, as having adequate growth potential for manufacture. The list of such identified branches & products is annexed at Schedule I of this chapter. Certain broad projections were also made of the likely production requirements in the principal identified branches & an order-of-magnitude figure was also indicated as to the likely capital investment requirements in such branches to cover the emerging production & technological gap in this critical sector of the Mexican economy.

Rationale for capital goods development:

3.5 Before defining the specific objectives to be achieved during Phase II of the Capital Goods Development Project, it is necessary to briefly consider the rationale behind the growing emphasis for increased capital-goods manufacture in the country. It is increasingly being recognised in Mexico that the growth of the capital goods sector is an essential link in the chain of industrial & technological progress & that rapid planned expansion of this sector represents a critical stage in the country's industrial growth. The machine-building sector is among the most dynamic sectors of manufacture, covering as it does, the production of mechanical, electrical & transport equipment which are utilised as machinery & equipment in various production sectors. Such a wide coverage inevitably has considerable ramification in terms of forward & backward linkages with basic industries & the engineering goods sector. With expansion of Mexico's industrial base, the demand for machinery and equipment has grown at an increasingly accelerated pace, resulting in the gradual growth of an adequate internal market for various machinery products. This has also been accompanied by infra-structural growth & the development of resource inputs such as processed industrial materials, production of parts & components & a base of industrial skills & aptitudes. Despite this, however, the transition to the manufacture of sophisticated machinery products is proving very difficult & the comparatively higher capital outlays required, the larger gestation periods & the unfavourable investment-output ratio in the early years of production which are often features of machine building enterprises, necessitates more specific measures to ensure adequate resource allocation to this basic sector.



3.7 The programming of capital-goods manufacture is a fairly complex task & all the more so in a mixed economy such as that of Mexico & must essentially be viewed as a long-term operation. The sector is very diverse in its coverage, extending from the production of small parts & components to large & sophisticated machinery products, involving high-quality castings & forgings, heavy fabrication, precision machining, heat treatment & a number of skilled techniques & operations. In most cases, the manufacturing facilities required are of a multi-purpose nature & the equipment can usually be utilised for a wide variety of products. Programming this sector consequently needs to cover not only the identification of specific machinery products whose manufacture can be economically undertaken, but also to evaluate various production possibilities in terms of socio-economic costs & benefits so that the manufacturing priorities can be clearly defined & assembled into appropriate product groups & ranges in each identified project. The investment priorities thus defined have, in the case of free-market economies such as in Mexico, thereafter to be dovetailed into an appropriate programme of investment promotion & resource mobilisation in respect of the identified machinery subsectors & projects. The programming function in Mexico is fundamentally different from that in socialist countries such as the USSR where material balances can & need to be constructed. It is necessary in the case of the former that such sectoral programming is viewed as a dynamic & pragmatic function which has to be tailored to investment responses, though such responses can be channelised through significant policy measures towards certain directions of investment & resource allocation. The preparation of any sectoral development programme has necessarily, therefore, to take account of this basic factor.

3.8 The overall objective of sectoral programming for this industrial branch should be to cover the significant production & technological gaps in the economy to the extent of economic feasibility and on a system of broad priorities. It is also essential to develop export capability for sophisticated machinery products as this would be very significant for the achievement of economies of scale for particular projects. Export capability can, however, largely follow the acceptance of a product initially in the home market on relatively competitive terms. The process of import substitution cannot be pursued beyond a limited point, unless internal demand growth is high and sustained or an adequate export capability is developed over a period of time. Other factors such as scale economics, access to an absorption of technological development and productive efficiency in terms of international competitiveness also need to be adequately achieved before machine-building projects can achieve substantial export orientation in a

*fiercely competitive international market. These aspects do not detract from the basic need of careful sectoral programming in the context of Mexico's specific circumstances and factor endowments, so that capital-goods production can achieve economic and efficient levels, and can stand the test of international competition within a reasonable period of time.*

3.9 *It is against this basic rationale for capital-goods production that the growth of this sector in Mexico should be viewed. While the demand for such producer goods has risen rapidly with progressive stages of industrialisation, domestic manufacture of machinery has tended to lag far behind, creating a structural imbalance. For balanced industrial development, it is necessary that the capital-goods sector must grow in close harmony & intrinsic relationship with general industrial progress. The absorption of machine-building technology is an important stage of industrial, technological progress. Apart from the direct technological & production benefits, the growth of this sector acts as a strong catalytic factor for the growth of the engineering goods sector in general. Despite the need, however, the growth of this sector in Mexico has been markedly slow. Till the late 1950's the market for most machinery products was relatively limited and industrial expansion was largely concentrated in the consumer goods sector & for intermediate products. At the same time, no specific policy emphasis was given for machinery production till fairly recently, except by way of limited import substitution during the last decade. The domestic machinery sector has in general, had to face considerable foreign competition, partly because of the special concessions accorded on imports of original equipment & partly because of the constant recourse taken to foreign supplier credits for resources reasons & in view of the relatively high cost of domestic capital. The fact that important machinery consumers have been able to import substantial quantities of machinery which can be locally manufactured is another important reason why only limited investible resources have been channelised into this sector. The nature of machinery manufacture, often involving long gestation periods, low initial profitability, substantial capital outlays & high technology costs have also limited against a rapid growth of this sector in Mexico. In most developing countries, the growth of this sector requires an effective, deliberative & co-ordinated policy & this is equally applicable in the case of Mexico. The opportunities in this country are, however, much greater. With an abundant, relatively cheap & mechanically-endowed labour force, a rapidly growing domestic market & geographical proximity to the U.S.A. & Latin American markets, Mexico has certain significant factor endowments in its favour.*

What is, however, necessary is a concerted & co-ordinated programme for resource channelisation in this sector & the creation of conditions under which sectoral growth can take place effectively & rapidly.

Objectives of Phase II:

3.10 The objectives of this phase of the Capital Goods Development Project must necessarily be viewed in the above context. This phase (Phase II) is essentially a continuation & follow up of the techno-economic studies conducted during Phase I of this project. During the present Phase II, the principal objectives of the project were (a) to prepare pre-investment studies for selected machinery groups & products from among the identified capital-goods subsectors, (b) to undertake investment promotion activities for the selected machinery branches, both by way of new projects & expansion of existing enterprises in Mexico (c) to define patterns of investment & technological participation for specific projects, in terms of foreign capital participation, technology costs, contractual arrangements & the like (d) to assist & participate in negotiations, both preliminary & detailed in respect of specific projects & proposals & to prepare techno-economic evaluation of such proposals (e) to define the principal policy aspects of machinery production in general & specific projects in particular & (f) to up-date the projections of demand & imports for the period 1976-1980 & to draw up projections for the period 1981-5, at 1974 prices, with a view to review the identification of machinery products & groups & define new priorities to the extent necessary.

3.11 The selected capital-goods branches in respect of which pre-investment studies were to be prepared & investment promotion & negotiations activities undertaken during Phase II can be considered under three broad categories (I) electrical machinery & equipment (II) mechanical equipment for common use & (III) mechanical equipment for specific industries. The list of the selected subsectors under each category is given below:

(I) Electrical machinery & equipment:

- (a) High voltage transformers
- (b) High voltage power circuit breakers
- (c) Electric motors & generators (AC & DC)

- (d) High voltage porcelain insulators
- (e) Hydro turbines
- (f) High pressure boilers for power stations

(II) Mechanical Equipment (for common use):

- (a) Machine Tools
- (b) Diesel Engines
- (c) Steam Turbines
- (d) Pumps & compressors
- (e) Medium & heavy castings (3 to 15 tons in weight)
- (f) Gears & speed reducers

(III) Mechanical Equipment (for specific industries):

- (a) Textile machinery
- (b) Machinery & equipment for iron & steel industry
- (c) Equipment for chemical & petrochemical industry
- (d) Food processing equipment
- (e) Heavy mechanical equipment for cement, paper & pulp, sugar and other industries.

3.12 Of this list, pre-investment studies were completed for 14 subsectors through UNIDO experts & one subsector through an UNIDO consultant agency, while the study relating to iron & steel equipment will be completed by end-May 1976. In two subsectors viz food processing & heavy mechanical equipment for cement, paper & pulp & other industries, UNIDO experts were earlier due to join in 1976. Investment promotion activities have been undertaken fairly effectively in most of the above subsectors particularly after completion of the pre-investment studies. These activities are discussed at greater length in the next Chapter.

3.13 The Mexican Capital-Goods Development Programme was conceived & must be viewed as, a pragmatic & realistic programme for the identification, promotion & development of production in the principal capital goods branches in the country. It should not be considered as a comprehensive blueprint of manufacturing activity in the entire engineering goods sector, based on a complete economic model & extending to material balances for the economy as a whole. The nature & intent of the techno-economic studies were primarily to highlight the machinery production branches where more intensified manufacturing activities were called for in the light of rapidly growing internal demand & increased potential for such manufacture & thereafter to prepare the

*groundwork, through pre-investment studies & promotional activities, for specific investment decisions by new or existing enterprises. Consequently, it was not attempted to prepare any detailed economic model nor even a detailed sectoral model, except in relation to projected demand & imports for various machinery products. From this viewpoint, the activities under this programme fall considerably short of detailed programming. At the same time, the results of the project can be judged more appropriately in terms of the considerable investment activity generated & the great stimulation of interest in capital-goods manufacture in this country.*

Schedule I

Capital-goods items identified as having adequate growth potential for manufacture in Mexico

This list includes Capital-Goods which could be fabricated under the following conditions:

I Through new facilities.

II Through planned expansion of existing industries.

III Through normal growth of existing enterprises.

The Symbols I, II, III are noted against each item, as are appropriate.

A. NON-ELECTRICAL EQUIPMENT. (Common use).

1. Heavy diesel Engines (1000-6000 HP) for generation, pumping and marine use. I
2. Steam Turbines for industrial use. (up to 6000 HP)
3. Machine-tools: I-chip removing.
  - a. Turret lathes with bar capacity  $\phi$  40, 50, 63mm.
  - b. Single spindle bar and chucking automatics with bar capacity  $\phi$  25, 40, 63 mm.
  - c. Universal cylindrical grinding machines with centre height 125 to 150 mm and centre widths 600, 1000, 1500 mm.
  - d. Surface grinding machines with table size 315 to 400 mm x 1000 to 1500 mm.
  - e. Universal tool and cutter grinding machines with centre width 500 to 630 mm.
  - f. Heavy duty knee-type milling machines horizontal, universal and vertical, with table size 315 to 500 mm x 1250 to 2000 mm.
  - g. Heavy duty pillar type drilling machines with capacity  $\phi$  30, 40, 50, 65 mm.
  - h. Radial drilling machines with capacity 40, 50, 63, 80 mm.
  - i. Shaping machines with ram stroke 450, 630, 800 mm.
  - j. Hacksawing machines with cutting range  $\phi$  400 mm.
  - k. Vertical band sawing machines with throat 500 mm.
  - l. Cold circular sawing machines with saw blade diameters of 400 and 630 mm.

4. Machine tools: II Chipless forming.
  - a. Open gap hydraulic presses with capacity 80 to 250 MT, for straightening, bending, marking, calibrating, deep-drawing, etc.
  - b. Spark erosion machines with mounting table 190 x 280 mm upto 600 x 1000 mm., including integrators with taper shank Morse 3.
  - c. Ingot, billet and slab shears (universal iron workers) with shearing strength 150 to 1250 MT.
  - d. Asymetric power driven sheet metal bending rolls with capacity 10 to 50 mm plate thickness and working range 1500 to 6000 mm.
  
5. Packaging, Spraying and weighing equipment.
  - a. Packaging equipment II
  - b. Continuous weighing equipment with automatic indicator or printing mechanism II
  - c. Spraying equipment III
  
6. Heating and cooling equipment.
  - a. Ovens and heat exchangers II
  
7. Pumps, Centrifuges and Compressors.
  - a. Heavy-duty pumps for water supply, sewage, boiler feed, mining & petroleum industries and for general industrial use I
  - b. Centrifuges mainly for sugar and chemical industries I
  - c. Heavy-duty compressors for mining & petroleum industries and for general industrial use. I
  
8. Conveying and loading equipment. I
  - a. Parts and components for bridge cranes
  - b. Port handling equipment
  - c. Tower cranes for construction industry
  
9. Gray iron foundry for medium castings (100 Kg. to 3000 Kg.) and also for heavy castings (3 to 15 MT) I
  
10. Production of gears, speed reducers and precision forgings, with a range of maximum diameter of 630 mm. (solid blanks) I
  
11. Production of measuring tools of various types I

12. Manufacture of standard parts for utilization in tools, jigs, dies, fixtures, moulds, gauges, patterns, etc I
  
- B. NON-ELECTRICAL EQUIPMENT (Specific Use).
1. Mining and construction equipment II
  - a. Mobile drilling machinery
  - b. Industrial tractors (caterpillar type)
2. Equipment for cement production I
3. Equipment for pulp and paper production I
  - a. Paper making equipment including winders suitable for paper mills of 200 to 500 TPD capacity
4. Food processing equipment I
5. Equipment for chemical and petrochemical industries II
6. Textile machinery and equipment I
  - a. Spinning extruding
  - b. Continuous fibre making
  - c. Weaving, knitting or suitable alternatives
  - d. Auxiliary machines and spare parts
  
- C. ELECTRICAL EQUIPMENT.
1. High-pressure boilers for power stations I
2. High-voltage power transformer (230 and 400 KV) I
3. High-voltage power circuit breakers (110, 230 and 400 KV) I
4. Motors and generators for AC and DC upto 10,000 KW I
5. High-voltage porcelain insulators for transmission lines, bushings etc. upto 400 KV. I
6. Telecommunications equipment: microwave and VHF equipment only I
7. Electric furnaces (above 12 MT) - arc and other types of welding (and gas cutting) equipment II



## II. PROJECT ACTIVITIES AND METHODOLOGY

4. The activities of the project together with the methodology followed during Phase II can be considered under the following principal heads: (a) preparation of pre-investment studies for identified machinery groups, (b) investment promotion activities in selected projects, (c) negotiations relating to specific projects (d) techno-economic evaluation of specific projects & proposals (e) updating of demand & import projections for 1976-80 & preparation of estimates for 1981-85 & (f) consideration of general policy aspects of machinery manufacture in Mexico. The first three aspects are dealt with in this chapter, in general terms & more specifically in Chapter IV & VI. Demand & import projections are covered in the next chapter while policy and procedural aspects are dealt with in the last chapter.

### 5.1 Pre-investment studies:

As pointed out earlier, project activities in Phase II commenced effectively only in March-April 1974, particularly in respect of preparation of pre-investment studies. From March 1974 to March 1976, 14 pre-investment studies were undertaken & completed by UNIDO experts & their counterparts in Nacional Financiera for the following branches: (a) high - pressure boilers for power stations (b) transformers (c) circuit breakers (d) electrical motors & generators (e) porcelain insulators (f) machine tools of various categories (g) pumps & compressors (h) diesel engines (i) foundry facilities (j) production of gears, speed reducers etc, (k) chemical & petrochemical equipment (l) textile equipment (prepared by a firm of consultants appointed by UNIDO) (m) production of hydro-turbines & (n) an initial report on equipment for the iron & steel industry. The pre-investment study for iron & steel plant equipment would be completed by end May 1976. Besides a pre-investment study on the manufacture of steam turbines was prepared by a British firm, largely on the basis of data collected by the Group.

5.2 It was sought to be co-ordinated, though the Project Manager, that the various pre-investment studies would follow a uniform format to the extent possible. This was not always practicable because of the specific background of particular experts, the details of data & information available for various branches & the specific approach considered necessary for a particular machinery group. However, to the extent feasible, the pre-investment studies were intended to cover (a) an estimate of projected domestic demand for a minimum

of 5 years (b) an analysis of existing & projected domestic manufacturing capacity (c) determination of principal input costs & domestic production costs (d) recommendations as to additional manufacturing or technological capacity & whether in the form of a new project or by way of expansion of existing enterprises. (e) estimates of capital investment that such additional production capacity may entail & (f) a broad economic valuation of the benefits accruing from such additional investment. Specific locations were not suggested but the general assumption made was that new projects would be located in Zone III. Product value was either assumed at competitive levels or with maximum differential of 20-25% over imported costs. The above pattern was followed in many of the studies, particularly those relating to transformers, circuit-breakers, motors & generators, foundry, production of gears & speed reducers & textile equipment. In certain cases, the initial study prepared by the UNIDO group was supplemented considerably by more detailed studies undertaken by the NAFINSA counterpart personnel. This was particularly so in respect of insulators, circuit-breakers & foundry facilities. In certain sectors, particularly machine tools, the initial study was essentially of a more general nature, partly because of non-availability of basic data. However, this study identified the specific machine tool branches having potential for domestic manufacture. The initial study on machine tool production possibilities has since been followed up by a more detailed study, covering specific machine tool branches in considerable detail. In certain branches, such as pumps & compressors & diesel engines, the initial pre-investment studies covered domestic market projections but principally stressed the need for expansion of existing facilities to cover growing internal demand.

5.3 The pre-investment studies were prepared largely by the short term (3 to 9 months) UNIDO experts, in collaboration with their NAFINSA counterparts. Extensive field investigations were conducted for this purpose & a large number of plant visits to existing enterprises were conducted, together with meetings with the principal users of the machinery product or products in question. More than 70 domestic plants were visited by one or other of the experts, though many of these plants had been visited in the earlier Phase also. Though relevant information was generally supplied by the enterprises visited, collection of detailed data re production sales, operating and other costs, future expansion programmes & the like, undoubtedly posed considerable problems in a number of cases & the Group had necessarily to base its conclusions on a number of assumptions, in some of the studies. By & large, however, most of the studies were able to cover the principal features of the market & the technical aspects

of additional manufacturing capacity. Once the technical studies were completed, the Project Evaluator in the Group was required to prepare the economic aspects of the project, in consultation with the Project Manager & the short-term expert concerned.

5.4 The main objective of the pre-investment studies was to define the size of the market & the broad economic potential of manufacture of specific machinery products in sufficient detail so as to enable effective investment promotion of particular projects. It was not intended that the pre-investment studies would be adequate for investment decisions as such. In fact, an important assumption which was fully confirmed by experience in the Capital Goods Project has been that pre-investment studies invariably require substantial modification in the course of investment promotion & the development of specific investment propositions with intending entrepreneurs. Almost invariably, the specific projects that have developed in one or other of the capital goods branches have been considerably different in concept & magnitude. This does not, in any way, detract from the essential need & value of these studies, as these constitute the basic framework for the specific investment propositions that have developed in the course of negotiations with entrepreneurial groups. In succeeding chapters, this aspect has been elaborated in respect of the main identified capital goods branches.

5.5 While no major difficulties were experienced in defining the broad scope of the pre-investment studies, some problems were undoubtedly encountered in the detailed preparation of many of the studies. With limited time at their disposal, the short-term UNIDO experts were often hard put to collect the required basic data regarding their respective branches. While generally, the response of domestic enterprises was positive & co-operative, there was considerable difficulty in obtaining details as to costs etc in a number of cases. In some instances, the principal users including large public sector enterprises, were reluctant to indicate preferences as to types of machinery products lest this should be interpreted as even an indirect commitment for subsequent purchase. The classification of imports in various broad categories also posed considerable difficulties in terms of break-up under different sizes & specifications. Despite the various practical difficulties encountered however, the pre-investment studies proceeded fairly satisfactorily & did succeed in providing, in most cases an adequate framework for the promotion of specific manufacturing projects.

5.6 For the purpose of the pre-investigation studies, certain assumptions were adopted, which are briefly enumerated below. The list of items is illustrative & not exhaustive. In a number of discussions & exploratory negotiations with potential foreign investors, similar assumptions were suggested by the Group & were generally accepted. (a) Debt-equity ratio: This was generally assumed at 1.1. This is somewhat at variance with current practice in Mexico where a higher proportion of equity is normally assumed, partly because of the relatively high cost of loan capital. In new machinery production projects, a more prevalent practice is to initially work on a 1.1 ratio (US, UK, FRG, India) & this ratio was consequently assumed for the pre-investment studies where new projects were considered necessary. In the case of expansions of existing enterprises, this had necessarily to be considered in the context of the financial structure of the company. (b) Cost of land: This was generally assumed at 40 to 50 pesos per square metre. Since most of the projects would be located in Zone III (outside the industrial concentrations of Mexico City, Monterrey & Guadalajara) such cost assumption was considered quite adequate. (c) Civil constructions: The estimates in this regard are rising rapidly every year. However for most of the projects, it was assumed that construction of light factory bays would cost about 1600 pesos per m<sup>2</sup> while heavy bays would cost around 3000 pesos per m<sup>2</sup> metre. Administrative offices, laboratory buildings, canteen etc were estimated at 2500 pesos per m<sup>2</sup>. Certain assumptions were also made for the cost of railroad sidings, land improvements, internal roads, ducts etc & for office fixtures etc. Crainage was assumed to cost 450,000 pesos for a 150-ton crane, 375,000 pesos for 100-ton boll at international prices since these may require to be imported. Units upto 50 tons & even more could, however, be obtained domestically, though at higher per ton prices (d) Machinery & equipment: It was sought to obtain quotations for some of the principal machinery items but this was not always possible. However, the estimates in this regard have sought to incorporate international machinery costs at 1974 prices as far as practicable. Since most of the machinery & equipment would require to be imported, provisions for freight & insurance was assumed at 10% on FOB, while local handling, transport & other costs were estimated at 7%. Import duties were assumed at 8%, which was the normal rate prevailing in 1974. Thus, a total additional cost of 25% was added to convert to cif. & including import duties. (e) Cost of capital: It was assumed that loan capital would be obtained from Mexican sources. Consequently, an interest rate of 13-15% was assumed in the pre-investment studies. The relatively high cost

of capital has encouraged the utilisation of supplier credits even in some projects negotiated under this programme. (f) Amortisation & depreciation: An amortisation period of 15 years with two years grace, was assumed in the various studies. Depreciation was calculated in accordance with the rates permissible in Mexico viz 8% for machinery, 3% for buildings & 20% for transport equipment. (g) Cost of labour: This constituted a fairly difficult problem as both the minimum & average rates varied considerably for different regions & for different categories of skills. By & large, however, a rate of 18 pesos per hour, including fringe benefits was considered a suitable base, though there were considerable variations for particular skill categories & locations. Overall salary increases have been quite substantial during 1974 & 1975 & this aspect will need to be carefully reviewed towards end 1976. (h) Cost of supervisory personnel: These were generally adopted on the basis of actual experience in the same or allied industry in Mexico (i) Royalty: For purposes of calculation, a rate of 3% was generally assumed as most the projects envisaged foreign licensing, at least in the initial period. (j) Taxes: Corporation Tax (impuesto sobre la renta) has been assessed at 42% of net profit, while provision of 8% has been assumed by way of project sharing (k) Incentives: Since these would largely depend on the location of the project on the tax rebate allowed on each case, no specific provision was incorporated in the various pre-investment studies on this account.

5.7 Certain methodological aspects & limitations of the techno-economic studies need to be specifically mentioned. Firstly, no sensitivity analysis was done at the stage of pre-investment studies in terms of calculating a project's worth in relation to fluctuations in the principal variables as market share of total demand, product pricing, input-output ratios & the like. This was partly due to the limitation of time for these studies & partly because such 'sensitivity' would, in many cases, be determined in any event in the course of investment promotion & finalisation of specific projects. It would, however, be undoubtedly useful if such sensitivity analysis could be undertaken in the next phase of the project, when most of the pre-investment studies can be expected to be translated into concrete projects. Secondly, the cost-benefit analysis for the specific projects identified in the pre-investment studies were primarily from the commercial viewpoint of individual projects though certain national criteria were also applied in some cases. The emphasis on commercial profitability was primarily because these studies were intended as the first step towards entrepreneurial investment decisions.

Normally, the Discounted Cash Flow technique was utilised for the purpose of project evaluation, the period extending over 10 to 15 years. In some of the studies, the IRR was calculated at a defined point of investment and sales income. In respect of national cost-benefits, the aspects highlighted were largely confined to (a) foreign exchange implications (b) employment considerations & (c) training effects. Thirdly, the various capital-goods products & subsectors were studied on an individual basis, after the initial identification & selection of branches and it was not attempted to prescribe inter-se priorities between one or other project. This was partly because the various pre-investment studies were not undertaken simultaneously but, in fact, extended over a 2-year period upto March 1976, but even more so because the investor response to the various investment possibilities was very varied & spread over different periods of time for different branches & products. The various projects & proposals had necessarily to be handled & processed as they came up through various stages of investment promotion. Once the present stage of the pre-investment studies & specific project appraisal is over, say by Oct-Nov 1976, it would be useful & desirable to review the various projects & evaluate them in greater detail in terms of national cost-benefits & consequent priorities. Fourthly, it is necessary to consider the depth to which market studies need to be conducted at the stage of pre-investment studies. The pattern sought was that these should be adequate for developing sufficient investor response after which the detailed feasibility study would cover the market possibilities in full detail. The course adopted was largely dictated by purely pragmatic reasons of time & manpower resources but proved, in most cases, to be quite adequate for the purpose of obtaining suitable investor response.

5.8 The export possibilities of various projects were not specifically covered in the pre-investment studies as adequate information regarding potential export markets, particularly in South & Central America could not be readily obtained. It was intended that a specific study would be undertaken as part of the UNIDO/NAFINSA project during 1974-5 to assess the potential market in Latin America for the identified machinery products. This was, however, not possible to arrange. In the meanwhile, NAFINSA has been in touch with ECLA and a joint study in this regard is under consideration. It may be appropriate to emphasise certain aspects in this connection. Firstly, whatever the incentives provided for inter regional trade in capital goods within Latin America, a much greater potential for machinery exports from Mexico would be in the USA & Canada, particularly the former. Any major export effort would necessarily need

to concentrate on the U.S. market. Secondly, the concept of greater inter regional trade in capital goods in Latin America would necessitate a major review of the structure of tariff incentives within the region. At present, the LAFTA tariff agreements cannot be said to operate in favour of Mexico in so far as machinery products are concerned & the entire pattern would need to be carefully re-examined. It may be useful to combine the study of this question with regional collaboration in this field. Finally, it is necessary to re-emphasise that exports of sophisticated machinery & equipment can rarely be dissociated with their utilisation in home markets. While it is true that in some economies such as Singapore & Hongkong, production of certain machinery products, particularly electrical items is developing rapidly, the general global experience in respect of heavy mechanical & electrical equipment has been that such equipment is initially manufactured for home markets & gradually extended to export markets, as production units become more competitive & scale economies become increasingly operative.

5.9 The question of scale economies raises the important question of plant capacities recommended in the pre-investment studies for one or other product group. This question is difficult to deal with, as a number of machine-building plants have a composite product mix & are flexible enough to switch from one item of manufacture, say, reciprocating compressors to drilling rigs, without too much difficulty. A plant producing high pressure boilers can manufacture a wide range of metal-fabricated products, including pressure vessels, condensers, cooling equipment & the like. A machine tool plant producing a certain type of tool can adapt itself to an alternative mix of machine tool products with only marginal increase in equipment, but provided the necessary technology is available. A plant manufacturing power-generation equipment can adapt itself readily to produce, for example centrifugal compressors. This flexibility is all the more so in respect of mechanical equipment manufacture, involving heavy fabrication work. Such manufacturing units are in the nature of large engineering workshops with a wide range of machine tools, which can be utilised for production of various machinery products, once the design & technology is available. Having made the basic point, however, it is necessary to emphasise that for a number of machinery products, relatively long production runs are possible. Thus for manufacture of transformers, circuit breakers, motors & generators, porcelain insulators, steam turbines, diesel engines, & some of the other products covered in the pre-investment studies, plant sizes have been sought to be defined. The general pattern has been to recommend new plants

*designed to cover the overall market requirement. This is relatively easier to do & also projects better overall economic results. However, experience in this project has shown that entrepreneurial response in most branches has been to reduce the plant concept & size very significantly & to explore possibilities of subcontracting as far as possible. This is partly because of market uncertainties & is obviously to reduce initial capital investment, so that a project can grow with the market, rather than outstrip the market. In these cases, the lower initial capital investment tends to more than compensate for scale economics, at least in the initial years of production.*

### 6.1 Investment Promotion:

*Investment promotion activities during Phase II were initiated by an Investment Promotion meeting organised by UNIDO in Vienna in Oct. 1973. On behalf of Mexico, this meeting was attended by Lic. Guillermo Becker, & Lic. Julio de León, from the Secretaría de Industria y Comercio, Ings. Carlos Quiniana, Colín & Héctor Castro Ulloa on behalf of Nacional Financiera, besides the UNIDO Project Manager. Thirty six representatives attended the meeting on behalf of reputed machinery manufacturers in Europe. A list of the persons attending this meeting is annexed to this chapter. For this meeting, a number of investment profiles had been prepared by the Group on various capital-goods manufacturing possibilities in Mexico. The representatives from Mexico emphasised various aspects of Mexican policies & clarified a number of issues relating to foreign investment, technology & other policies in Mexico. There was considerable interest generated among a number of European manufacturers for participation in machine building projects in Mexico. The specific proposals which emanated from this meeting were (a) three proposals from French, German & Swiss companies for the manufacture of high-voltage circuit breakers in Mexico (b) four proposals from French, German, Swiss & Italian machine tool manufacturers to manufacture various categories of machine tools in Mexico (c) one letter of interest from a German company for production of power boilers (d) expression of interest from a Czech company to expand its facilities in Mexico (e) a joint project proposal from a British & a Germany company for the manufacture of steam turbines for industrial use. (f) an expression of interest from an UK company for production of electric motors, relays etc & (g) expression of interest from some European companies for participation of cement equipment, diesel engines, industrial pumps & the like. The follow-up & subsequent developments in respect of these proposals is discussed in the succeeding chapters.*



6.2 The meeting in Vienna was followed up by a series of meetings & exploratory negotiations in the USA & in Mexico over the last 2 years with a number of prospective foreign entrepreneurs & domestic industrial groups. For this purpose, letters of invitations were sent to the principal manufacturers of machinery & equipment & follow up meetings & explanatory discussions were held with those foreign manufacturers who expressed interest in participating financially or technologically in one or other of the identified projects. By & large, it can be said that most major manufacturers have been contacted by the Group over the last two years, except in certain fields such as chemical & food processing, machinery or equipment for iron & steel, paper & pulp, etc. where the initial studies have either not been concluded or completed very recently.

6.3 The rationale behind the procedure adopted for investment promotion was, that the sophisticated nature of capital goods production necessitates in many cases, not only the inflow of foreign technology but the active participation of technology suppliers in actual manufacture. This approach can of course be questioned on the ground that this may lead to excessive dependence on foreign technology & technology suppliers even over a period of time, particularly where technology is accompanied by a degree of capital ownership & consequent participation in the day to day operations of enterprises. Following the pattern of socialist countries in Europe, capital goods production has been undertaken in some developing countries such as India, Iran & Egypt through large, public-sector enterprises without any foreign capital participation, though such production is based on foreign technology. This is a matter, however, of state policy. In Mexico, where the declared policy of government is to encourage private-sector investment, as also foreign minority investment in new & necessary industries, it would be obviously inappropriate to operate under any other premise. The nature of most capital - goods production, involving large capital outlays & long gestation periods, is also such that foreign investment participation would not only be useful but desirable, both from the viewpoint of covering possible resource gap & so as to ensure that technology inflow is not only complete but continued & substantial over a period of time.

6.4 It must be emphasised, as experience in the Mexican Capital Goods Project has amply demonstrated, that the promotion of investment in capital goods manufacture is, by no means, an easy task. Though the technology market for machinery manufacture is oligopolistic, there are a number of sources available for obtaining

adequate technology in most of the branches. Yet, the need for obtaining the most suitable technology on the most acceptable terms & conditions makes the task of selectivity & negotiations extremely difficult. On the one hand, machinery users are keen that the most suitable equipment only is undertaken for production in Mexico & should be available at near-competitive international prices. In the selection of technology for steam turbines, for example, one of the principal institutional consumers in Mexico expressed little interest in the domestic production of 2-3 internationally known makes but appeared to be keen on principally one make, the manufacturers of which were not interested in participating in a project in Mexico. Similar instances have occurred in some of the other machinery products also. While, it is necessary to take full account of the opinion of principal users re brand names & makes, there is a point beyond which this could naturally affect the establishment of major machine building projects in the country. On the other hand, considerable problems have also been posed by suppliers of technology in some of the selected fields. Reputed international machinery groups have been reluctant to participate in investment projects except under certain conditions which, at times, have proved very rigorous. In some cases, this has been sought to be linked with commitments, on the part of Mexican institutions & public sector agencies to purchase their requirements solely from the new unit. In other cases, product pricing formula were suggested which were considerably above international prices. In some instances, project decisions have been sought to be linked with the placing of major orders against an existing quotation on the technology supplier for the product in question. The exercise of selectivity in the choice of foreign technology & related foreign investment had necessarily to take account of all these factors, which have resulted in the negotiations relating to a number of projects being fairly prolonged.

6.5 In respect of investment promotion activities of the project, it is necessary to emphasise the close collaboration between Nacional Financiera & the UNIDO Group, particularly the Project Manager. In almost every case, the initial contacts, through plant visits or correspondence, were made by the UNIDO/NAFINSA group on behalf of NAFINSA & the initial and detailed negotiations relating to a number of projects were conducted by NAFINSA officials in close consultation with the UNIDO Project Manager & some of the UNIDO experts. While final decision making naturally rested with Nacional Financiera, the various prior stages of processing the various proposals received were largely performed by the UNIDO/NAFINSA Group.

### 7.1 Evaluation:

Together with the exploratory & initial negotiations conducted with a number of foreign companies & domestic companies in Mexico, an important role discharged by the UNIDO/NAFINSA Group was the evaluation of various proposals received from a techno-economic viewpoint. The technical input in respect of such evaluation was largely provided by the short-term technical experts, while the economic aspects of the proposals were reviewed by the Project Manager, assisted by the Project Evaluator. The procedure followed was to prepare such evaluations & in consultation with NAFINSA counterparts, submit these to senior personnel in NAFINSA, who would conduct the negotiations, usually with the participation of the Project Manager. The procedures worked fairly satisfactorily during the period under report. The evaluation reports briefly analysed the principal features of such proposal & compared these with the approach adopted in the related pre-investment studies. In fields where more than one investment proposition was received, such as circuit-breakers, a brief comparative evaluation was prepared, with specific recommendations, for the consideration of NAFINSA.

7.2 An important aspect of such evaluation related to the proposals received in respect of technology licensing. In a number of cases, proposals received from prospective technology suppliers tended to be rather one-sided & contained many restrictive conditions, apart from being too expensive. A critical analysis of all such proposals was made by the Project Manager for consideration of NAFINSA, together with alternative contractual provisions & revised terms of remuneration. The revised contractual provisions formed the basis for final negotiations between NAFINSA & technology suppliers in a number of cases, while technology payments were also substantially reduced. In one case alone, technology payment was able to be reduced from US\$2 million to US \$400,000. By & large, the negotiations and approach adopted in respect of acquisition of technology should stand NAFINSA in good stead in respect of future negotiations & drafting of technology licensing contracts.

8. While the principal role of the UNIDO group, apart from preparation of pre-investment studies, lay in assistance & participation in investment promotion & negotiations, certain general aspects also emerged which, in the opinion of the Project Manager, are likely to prove extremely significant. These have been dealt with in Chapter VIII of this report & relate largely to policies & procedures considered necessary for the rapid growth of the capital-goods sector in Mexico.

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### III. DEMAND AND IMPORT PROJECTIONS FOR CAPITAL GOODS IN MEXICO DURING 1976-1980 and 1981-1985

8.1 In Phase I of the Capital Goods Project, fairly detailed demand & import projections were made for the period 1976-80, both for capital goods as a whole, as also specific machinery products. Firstly, macro projections were made of the machinery requirements of the principal production sectors in the economy. For this purpose, growth trends in terms of investment & output were defined for 14 production sectors which were the principal consumers of machinery products. These were agriculture, mining, food processing, sugar, textiles & shoes, paper & pulp, chemicals & petrochemicals, cement, iron & steel, non-ferrous metals, machine tool production, manufacture of electrical equipment, construction industry, & electricity power generation.\* From the projected investment trends for these production sectors, the capital-goods requirements for each sector were assessed, on the basis of co-efficients of machinery investment in each case. On the basis of 1967-68 prices, it was projected at that time that machinery requirements for these 14 sectors would be of the order of Ps 102.76 thousand million. While gross production of these sectors constituted about 50% of total gross production, the above estimates also gave a fairly reasonable indication of machinery demand for the economy as a whole. The figures were further broken down for specific machinery groups & products & import figures for the 1965-9 period were extrapolated (at constant 1967-8 prices) for the period 1976-80. This methodology was considered appropriate as import statistics provided a detailed uniform classification of various machinery products & groups. The period 1965-9 was assumed as a period of fairly rapid growth in most production sectors. Capital-goods imports during this period were of the order of Ps 36.5 thousand million. The extrapolated import projections indicated that capital-goods imports for 3 defined groups viz mechanical equipment of common use, mechanical equipment for specific industries & electrical equipment would be Ps 83.65 thousand million (1967-8 prices) during 1976-80. A fairly detailed survey through field visits & investigations was also made of domestic manufacturing capacity in different capital goods branches & this was separately set out for the major machine building sub-sectors. For the purpose of import projections it was, by & large, assumed that domestic manufacturing capacity would remain fairly static, though wherever the impact of new manufacturing capacity set up between 1968-9 & 1972-3 was considered to be significant, this was taken into account.

\* For a more detailed description of the methodology followed in determining these projections, reference is invited to Reports of Phase IA & IB.

8.2 The demand & import projections prepared in Phase I (1972) obviously required revision by 1975-6. On the one hand, machinery costs had escalated considerably during the period, between 1968 & 1975 & any projections based on 1967-8 prices tended to be unrealistic. Secondly, significant changes had occurred in the Mexican economy during the period between 1970 & 1975. Demand for machinery & equipment was rising rapidly & inflation at home & abroad had a significant effect in determining growth trends in different branches. It was consequently considered necessary to review the former projections of machinery imports and bring these upto date in terms of 1974 prices, and also to prepare detailed projections for the period 1981-5. The latter was considered particularly necessary as most machine-building projects taken up for implementation in 1976-7 would, in fact, be manufacturing in accordance with installed capacities only in the early 1980's. The detailed techno-economic studies conducted for the various capital-goods branches during Phase II would also serve to effectively cross-check the data & material regarding demand & import trends over the next decade.

8.3 By & large, the methodology adopted for updating the import projections for 1976-80 and preparation of 1981-5 estimates is similar in concept to that adopted during Phase I.\* The principal modifications in the definition of the production sectors is that (i) instead of 14 production sectors, 15 sectors have been projected including the printing industry (ii) in place of machine tool manufacture, the overall mechanical equipment production sector has been included as this covers a much wider section of manufacture. Growth rates have been projected for each of the 15 production sectors & capital goods requirements for each sector have been assessed. These 15 sectors represented 40.4% of GDP in 1974. The most significant capital-goods subsectors have been divided into 38 categories & the projections for each category of machinery against each production sector may be seen at Schedules I to III at the end of this chapter for the periods 1975-80, 1981-5, as also for 1970-4 (though inflated to 1974 prices) for purposes of comparison. A more detailed projection has also been made in respect of each machinery group & product to the 4-digit & 5-digit SITC classification.

8.4 The growth rates projected for the 15 production sectors may be seen in Table I below, together with projected value added

\* For a more detailed description of the methodology & procedure followed during the 1975 review, reference is invited to the final report of J. Zdenek, Domestic Market Analyst, Capital-Goods Project, Mexico (Feb. 1976).

figures of each sector for both periods, assuming an overall GDP growth rate of 6.5% during 1976-80 & 7% during 1981-5.

TABLE I

in million pesos

Growth projections of principal production sectors

<i>Sector</i>	<i>Growth rate assumed for 1976-80</i>	<i>Anticipated value-added in 1980 (1974 prices)</i>	<i>Growth rate assumed for 1981-5</i>	<i>Anticipated value-added in 1985 (1974 prices)</i>
1. Agriculture	2.9%	91,400	3.1%	106,500
2. Mining sector	4.8%	12,600	5.5%	16,500
3. Food processing industry	6.5%	68,100	6.0%	93,700
4. Sugar industry	7.1%	5,200	7.6%	7,500
5. Textile & shoes industry	7.2%	65,800	7.5%	94,500
6. Pulp & paper industry	8.2%	8,000	8.5%	12,000
7. Printing industry	7.1%	7,300	7.5%	10,500
8. Chemical industry	10%	73,900	10.5%	122,000
9. Iron & Steel industry	10.8%	12,500	9.1%	19,300
10. Cement industry	9.5%	4,550	10%	7,300
11. Non-ferrous metals industry	8.1%	5,400	8.5%	8,100
12. Non-electrical machinery industry	13.4%	9,400	12%	16,600
13. Electrical machinery industry	13.4%	13,700	11%	23,100
14. Construction industry	8.7%	87,100	9.2%	135,200
15. Electricity Generation	10.6%	19,400	8.6%	29,300
<b>TOTAL of 15 sectors</b>		<b>484,330</b>		<b>702,100</b>
<b>Remaining activities</b>		<b>678,470</b>		<b>928,900</b>
<b>GDP</b>		<b>1,162,800</b>		<b>1,631,000</b>

*In determining the growth projections, the past growth pattern & the estimates made in the various techno-economic studies have been taken into full account. It is necessary to emphasise that the various growth rates are estimated projections & there is possibility of a considerable degree of variation between these figures & those of other institutional sources making such projections for one or other sector. Unless, however, a very significant variation takes place, the figures of capital-goods requirements, which constitute the main purpose of the exercise would not be materially affected.*

*8.5 Together with determination of the growth rates for 15 of the principal machinery-consuming branches, the import figures upto 1974 were sought to be extrapolated for the two 5-year periods 1976-1980 & 1981-85. In order to project comparable figures for the various periods, it was first necessary to convert the 1970-1 import figures for a large number of machinery products to 1974 prices. This time-consuming task was, performed by the UNIDO expert - through the use of inflators, derived for each product on the basis of increases defined in the U.S. Wholesale Prices & Price Indices for the month of July in each of the years 1970, 1973 & 1974 & annual average increases defined by the same source for 1971 & 1972. These 'inflators' were cross-checked with machinery price indices in the Federal Republic of Germany over the same period & appear to be fairly accurate & acceptable.*

*8.6 In determining import projections for 1976-80 & 1981-85 (both at 1974 prices) careful account has been taken of growth in domestic manufacturing capacity of various machinery products particularly for sub-sectoral branches which have been studied in detail by the UNIDO-NAFIN Group. These sub-sectors are briefly discussed in the succeeding chapters dealing with manufacturing possibilities in Mexico for the three broad categories of capital-goods. It must be stressed, however, that the assessment of domestic production capacity does not extend to the other machinery sub-sectors in equal detail as those sub-sectors which have been specifically studied by the Group. This may well result in domestic production capacity being somewhat higher or lower for some of the subsectors but this again is not likely to materially affect the overall import projections. It must also be emphasised that the import projections do not take into account the various projects being contemplated as part of the Capital-Goods Development Programme. In fact, it is the production gaps represented by the import projections that provide the rationale for most of the various projects being sponsored by the UNIDO-NAFIN Group.*

8.7 The import projections for the two periods need to be viewed at two levels. Firstly, overall imports of capital-goods for the period 1976-80 (at 1974 prices) are projected at Ps 187.5 thousand million pesos while, for the period 1981-5, such imports are projected to rise to Ps 296.6 thousand million. The annual growth rate is expected to be 10.4% during 1976-80 & 8.5% in 1981-5. Secondly, it is necessary to consider what portion of such imports would be covered by the 38 identified groups of machinery products. Imports of these 38 identified machinery groups (Schedule I to III) would be of the order of Ps 115.7 thousand million during 1976-1980 & Ps 183 thousand million during 1981-5. This would constitute over 60% of total machinery imports during these periods. The former figure of Ps 115.7 thousand million can be compared to the earlier (1972-3) import estimate of Ps 83.6 thousand million pesos for similar categories of machinery & equipment during 1976-1980. During the year 1980, overall capital-goods imports are estimated to be Ps 45 thousand million pesos\* while for the 38 identified groups of machinery, imports would be around Ps 28 million.

8.8 In Table III which is annexed at the end of this chapter, import projections have been made for the principal machinery groups & products upto the 4-digits & in some cases, upto 5-digits of the Standard International Trade Classification (SITC) for the 1976-80 & 1981-85 periods at 1974 prices. The Table also shows the earlier projections made in 1972 for each of these machinery products at 1967 prices.

8.9 A comparative summary of the projected distribution of imports among the 15 production sectors is given in Table II at page 39. This has been a very difficult exercise as it necessitated application of broad machine co-efficients for each subsector as related to different machinery groups & products. Where the equipment for different sectors has been able to be separately classified such as for the electrical sector or pulp & paper industry, this has been separately provided, together with suitable proportionate projections in respect of the common-use machinery groups. However, in some major sectors such as the chemical & petrochemical industry, no separate sectoral classification has been practicable, as much of the equipment is of common-use category. In such a case, the only alternative was to estimate the proportionate machinery projections for each of the machinery groups & products, through the use of broad co-efficients as has been shown in Schedules I to III for the periods 1970-4, 1976-80 & 1981-85. While this method cannot

This figure, as also the overall import projection of Ps 187.5 million can be compared to a similar figure of Ps 15 thousand million for 1980 & overall imports of Ps 160-180 thousand million pesos for 1976-80 projected by the UNIDO-NAFIN Group in 1975 in an article "Programme for the Development of the Capital - Goods Industry in Mexico" which appeared in Comercio Exterior de México- Vol. II - No. 8, 1975.



be considered to be wholly accurate, this does serve to provide certain broad estimates which can serve as effective tools for programming. The above approach highlights the production sectors where the volume of projected imports is likely to be particularly heavy. The most significant sectors from the viewpoint of projected imports during 1976-85 would be (a) the chemical, fertiliser & petrochemical industry, (b) electrical power generation industry, (c) textile industry & (d) the mechanical (non-electrical) equipment industry. Both (b) & (d) cover a number of specific machinery groups & products. From this Table, the construction industry is also a major machinery consumer but the demand in this case relates primarily to special-purpose tractors & transport equipment, which have been excluded from this study. Other significant production sectors are (a) iron & steel industry (b) food processing industry & the electrical machinery industry.

8.10 The above projections highlight not only the overall magnitude of machinery imports projected for 1976-85 but the principal production sectors where the production gaps are likely to be most pronounced. These projections, however, fully bear out the emphasis that has been placed by the Capital-Goods Project on certain machinery subsectors, particularly electrical equipment & certain categories of mechanical equipment, both for common use as also for certain specific branches.

8.11 A summary of the projected imports for the 38 identified categories of machinery & equipment is annexed at Schedule IV to this chapter\*. While this again confirms the emphasis placed by the Capital-Goods Project on certain machinery sub-sectors which represent the most significant production gaps, it also draws attention to certain machinery subsectors where greater attention is required in future. The most important of these sectors is the food-processing industry, which needs to be examined in the near future. Certain specific machinery groups such as paper & pulp machinery, mineral crushing equipment, printing machinery & bearings of different types could also be studied in greater detail in the future.

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\* Reproduced from report of J. Zdenek (page 85)

TABLE No. II

PROJECTED CAPITAL GOODS IMPORTS DISTRIBUTED  
AMONG 15 SECTORS FOR PERIODS 1976-80 & 1981-85

(MILLION PESOS - 1974 PRICES)

Pos.	Name	1970-74	1976-80	1981-85
1.	Agriculture	3716	6000	7600
2.	Mining Industry	928	1200	1900
3.	Food Processing Industry	2291	4800	7000
4.	Sugar Industry	244	500	800
5.	Textile (& Shoe) Industry	6725	9800	14600
6.	Pulp & Paper Industry	1198	2415	4200
7.	Printing Industry	1133	2485	3700
8.	Chemical Industry (including fertilisers & petrochemicals)	7610	15860	29900
9.	Cement Industry	635	1500	2600
10.	Iron & Steel Industry	2511	5500	9000
11.	Non-Ferrous Metals Industry	776	1500	2300
12.	Mechanical (non-electrical) Machinery Industry	1875	7400	11100
13.	Electrical Machinery Industry	1405	4260	7400
14.	Construction Industry	5365	9600	15600
15.	Electricity Generation Industry	7324	14000	19100
		43730	86820	136800
	Remaining Activities	14949	28900	46400
	Capital Goods Imports for 38 identified categories	58679	115720	183200
	Non-Identified Capital Goods Imports	38321	71780	113400
	<b>Total Capital Goods Imports</b>	<b>97000</b>	<b>187500</b>	<b>296600</b>

TABLE No. III

PROJECTED CAPITAL GOODS IMPORTS - 1976-80 AND 1981-85

SECTION I - MECHANICAL MACHINERY AND EQUIPMENT FOR SPECIFIC INDUSTRIES

(in million pesos)

Classifications SITC	BTN	Machinery sub-sector	Projected imports	Projected imports	Projected imports
			1976-80 at 1967 prices & prepared in 1972-73 "A"	1976-80 at 1974 prices & revised in 1975 "B"	1981-85 at 1974 prices "C"
712.1	34.24	<u>Agricultural machinery and appliances</u>	439	351	445
		<u>Ag. mach. &amp; appl. for harvesting &amp; cultivating the soil</u>			
712.2	84.25	<u>Ag. mach. &amp; appl. for harvesting, threshing and sorting</u>	810	1217	1520
712.3		<u>Milking machines, cream separators, &amp; other dairy machinery</u>	61	139	190
712.5	87.01	<u>B 001 Agricultural tractors on wheels</u>	3528	1850	2700
712.5	87.01	<u>B 002 Agricultural tractors on caterpillars</u>		300	500
712.9		<u>Other agricultural machinery &amp; appliances</u>	150	170	225
717.1		<u>Machinery &amp; equipment for textile and shoe industry</u>			
717.11	84.36	<u>Textile machinery</u>	3047	9323	14015
		<u>Spinning, extruding etc. machines</u>	3216	5159	5200
717.12	84.37	<u>Weaving, knitting, etc. machines</u>	2596	3450	5300
717.13	84.38	<u>Auxiliary machines &amp; apparatus</u>	1081	713	1000
717.14	84.39	<u>Machinery for the manufacture or finishing of felt</u>	31	10	15
717.15	84.40	<u>Textile bleaching, washing, dressing, coating, printing, etc. machinery (excl. domestic mach.)</u>	1202	1700	2500
717.2	34.42	<u>Machinery for working hides, skins or leather (excl. sewing machines)</u>	276	282	410

Classifications		Machinery sub-sector	"A"	"B"	"C"
SITC	BTN				
717.3	84.41 B.D.E.	<u>Industrial sewing machines</u>	737	832	1280
718.1		<u>Paper mill and pulp mill industry</u>	1417	2538	4408
718.11	84.31	<u>Machinery for making or finishing cellulosic pulp, paper or paperboard</u>	905	1550	2708
		A. Machinery for making or finishing cellulosic pulp	216	340	620
		B. Paper or paperboard producing machinery	507	900	1550
		C. Spare parts	182	310	538
718.12	84.33	<u>Paper cutting machines &amp; other machinery for the manufacture of articles of paper pulp, paper or paperboard</u>	511	988	1700
718.2		<u>Printing and bookbinding machinery</u>	1806	3005	4525
718.21	84.32	<u>Bookbinding machinery</u>	158	240	360
718.22	84.34	<u>Type making &amp; setting machinery</u>	310	360	515
718.29	84.35	<u>Other printing machinery</u>	1333	2405	3620
718.3		<u>Food processing machines</u>	857	1147	1816
718.4		<u>Construction and mining machinery</u>	2598	3948	6280
718.41	84.09	<u>Mechanically propelled road rollers</u>	6	80	120
718.42	84.23	<u>Excavating levelling, boring and similar machinery</u>	2592	3868	6160
718.5		<u>Mineral crushing machinery</u> (principally for mining, cement and construction industry)	1382	2550	4330
718.51	84.56	<u>Mineral crushing, sorting, etc. machinery</u>	1159	2250	3700
718.52	84.57	<u>Glassworking machinery</u>	223	340	630

**SECTION II - MECHANICAL MACHINERY AND EQUIPMENT FOR COMMON USE**

Classifications		Machinery sub-sector	"A"	"B"	"C"
SITC	BTN				
711.1	84.01	<u>Steam generating boilers &amp; boiler house plants</u>	2261	900	1350
711.2	84.02				
<p>The above estimates have been made on an assumption of annual power generation of 600 MW during 1976-80 and 900 MW during 1981-85 through thermal stations. Consequently there will be demand for power stations boilers of up to 300 MW output during both periods. An average price of 600 Pesos per KW has been assessed for the entire range of power boilers. Domestic integration has been assumed at 60%. About 20% of the imports in this group is anticipated for the chemical industry.</p>					
711.3	84.04	<u>Steam engines &amp; gas turbines</u>	2092	2050	3100
711.6	84.05				
<p>The above figures include anticipated imports of turbines both for power stations as for industrial purposes. The estimate also includes likely imports of turbines driven by diesel engines up to 300 HP being made in Mexico at present.</p>					
711.5	84.06	<u>Internal combustion engines, others than for aircraft</u>	4812	6346	10562
<p>B to F</p>					

About 50% of the projected imports are anticipated in spare parts and accessories which are required for domestic automobile production. As this industrial activity has been excluded from the analysis, no detailed breakdown of the projection of spare parts and accessories has been included. The imports of some of these items as e.g. monoblocks and cylinder heads for engines, pistons and piston rings, however, are expected to reach a significant level which would justify expansion of existing production or new facilities.

Classifications		Machinery sub-sector	"A"	"B"	"C"
SITC	BTN				

A special group relates to diesel engines for ships. Here two important sublines are anticipated:

84.06	B 001	Out-board marine engines	114	280	450
84.06	B 002	Diesel marine engines with output of 250-6500 HP	200	400	700
711.8	84.07	Other engines (hydraulic turbines, wind motors, etc.)	484	1600	2750
	84.08				
	C to E				

The major increase in anticipated imports on account of hydro-turbines is owing to much greater emphasis on hydro-electric power during the next 10 year period. Hydro-power generation is expected to increase from 3900 MW in 1975 to 7200 MW in 1985.

719.1		<u>Heating and cooling equipment</u>	4063	6522	10265
719.11	84.03	Gas generators	66	260	400
719.12	84.12	Air-conditioning machines	201	180	300
719.13	84.13	Furnace burners, mechanical stokers, etc.	149	202	319
719.14	84.14	Non-electric industrial and laboratory furnaces and ovens	1364	1500	2200
719.15	84.15	Refrigerators (other than domestic) and other refrigerating equipment or not electrical	159	520	820
719.19	84.17	Other apparatus for treating materials with heat or cold (heat exchangers, vulcanizers, separators, apparatus for fractional distillation or rectification, evaporators, etc.)	2131	3860	6235
715.1	84.45	<u>Machine tools for working metals</u>	1582	6850	9560
		A. Lathes	915	1510	2150
		B. Grinding machines, polishing, honing machines	630	930	1390
		C. Milling machines		620	870
		D. Boring mills, shaping, planing, filing, slotting machines	365	410	570
		E. Sawing equipment	72	100	130
		<u>Subtotal: Metal-cutting machine tools</u>	3432	4440	6195







Classifications		Machinery sub-sector	"A"	"B"	"C"
SITC	BTN				
719.9		<u>Parts and accessories of machinery</u>	<u>4280</u>	<u>7204</u>	<u>11688</u>
719.91	84.00	Moulding boxes for metal foundry and moulds, other than ingot moulds	565	1080	1750
		Main subitem: A 002 Steel moulds for injection or compression machines			
		transforming plastic materials	162	390	600
719.92	84.01	Taps, cocks, valves and similar appliances	1219	1800	3018
719.93	84.03	<u>Transmission valves and cranks, pulleys, etc.</u>	1904	367	5900
719.94	84.04	Metal-plastic joints (gaskets)	136	290	450
719.99	84.65	Non-electrical machinery parts	457	360	570

SECTION III - ELECTRICAL MACHINERY AND EQUIPMENT

<u>Classifications</u>		Machinery sub-sector	"A"	"B"	"C"
SITC	BTN				
722.1	85.01	<u>Electric Power Machinery</u> A <u>Generating machines</u>	5718 <u>2423</u>	6000 <u>2240</u>	9600 <u>3830</u>
<p>The estimates were based on projections of increase of generating capacity, both hydro and thermal during the 10 year period and consequential estimate for generators for power stations. In addition, the estimates have included likely requirements for small AC and DC generators, diesel generators for distant stations, peak-loads and specific industrial and another uses (about 1/3 of the totals).</p>					
		B <u>Motors</u>	1360	1250	2100
		D <u>Static transformers</u>	922	1320	1740
722.2	85.19	<u>Electrical apparatus for making and breaking or for protecting electrical circuits</u>	<u>3496</u>	<u>4993</u>	<u>7555</u>
		A <u>Apparatus for breaking circuits and for sectioning, etc.</u>	1250	1700	2600
		C <u>Splice and connecting apparatus</u>	184	380	570
		D <u>Non-heating resistors, potentiometers or rheostats</u>	130	200	300
		E <u>Control and distribution boards</u>	583	750	1135
		G <u>Spare parts</u>	214	663	900
723.1	85.23	<u>Insulated wire and cable</u>	489	564	788
723.2		<u>Electrical insulating equipment</u>	<u>773</u>	<u>958</u>	<u>1530</u>
723.21	85.25	<u>Electrical insulators</u>	551	600	900
723.22	85.25	<u>Other insulating fittings for electrical equipment</u>	222	380	620
723.23	85.27	<u>Electrical line telephone and telegraph equipments</u>		8	10

The assessed imports of porcelain insulators acc. to the Study "Requirements of Porcelain Insulators in the Mexican Electrical Sector" (Nafinsa-September, 1975), are almost 390 mill. pesos for 1976-87 which is almost 40% of the imports of the entire group. This share is nearly equal to that of the last 5 years.

Classifications		Machinery sub-sector		
SITC	BTN	"A"	"B"	"C"
729.2	90.20	320	701	1110
				<u>X-ray apparatus</u>
729.3	85.21B	1870	462	758
				<u>Photocells, transistors and other semiconductor elements</u>
729.5		1396	3592	6234
729.51	90.26	28	610	1051
729.52	90.28	1308	2982	5180
				<u>Electrical measuring instruments</u>
				<u>Gas and electricity supply meters</u>
				<u>Other electrical measuring and controlling instruments and apparatus</u>
729.6	85.05	222	314	719
				<u>Electro-mechanical hand-tools</u>
729.12	85.04			
729.91	85.02			
729.92	85.11			
729.95	85.18			
729.96	85.24			
				<u>Electrical accumulators, electro-magnets</u>
				<u>Electric furnaces, electric welding and cutting apparatus, electrical condensers (capacitors), electrical carbons,</u>
692.11	73.22	324	179	330
				<u>Tanks, etc. for storage or manufacturing use made of iron or steel</u>
695.2		1820	4123	3112
695.24	82.05	1039	1950	3159
				<u>Other tools for use manually or in machines</u>
				<u>Interchangeable tools for hand or machine tools</u>
695.25	82.06	101	143	250
695.26	82.07	62	30	42
				<u>Cutting blades for machines</u>
				<u>Tool tips, unmounted, made of sintered metal carbides.</u>

SCHEDULE II

MATRIX TABLE OF DISTRIBUTION OF CAPITAL GOODS IMPORT GROUPS AMONG 13 PRINCIPAL INDUSTRIES

Period A (1976 - 1980) (1971 prices) (in million rupees)

Sl. No.	Description of Capital Goods Group	HS Code	Principal Industries												
			1	2	3	4	5	6	7	8	9	10	11	12	13
			Agriculture	Mining	Food Processing	Sugar	Textile & Stone	Pulp & Paper	Printing	Chemical	Cement	Iron & Steel	Non-ferrous metals	Non-electric machinery	Electric machinery
1.	Steam generating boilers & boiler house plants	711.182								145		5			
2.	Steam engines & gas turbines	711.300		3	6			6	6	130	6	21	12		
3.	Internal combustion engines	711.300	100	44	21	5				1510	29	43	12	40	
4.	Engines, n.e.s.	711.300		15	15			15	10	10		15	30		
5.	Agricultural machinery for cultivating the soil	712.100	334												
6.	Agricultural machinery for harvesting, etc.	712.200	1247												
7.	Milling machines, cream separators, etc.	712.200	24		112										
8.	Tractors, other than road tractors	712.200	2151	93	18					93	75	55	15		
9.	Agricultural machinery and appliances, n.e.s.	712.200	117		32										
10.	Machine tools for working metals	713.100	40	10	35	5	7	2		370	15	530	100	2050	1025
11.	Machine tools for working non-ferrous metals	713.100										1500	400	210	
12.	Textile machinery	717.100						2403		260					
13.	Machinery for working hides, skins or leather	717.200						292							
14.	Printing machines	717.200						370							
15.	Paper mill, pulp mill machinery	717.200							1030	418					
16.	Printing and bookbinding machinery	717.200							155	270					
17.	Food processing machines (excluding domestic)	718.100	30		1127										
18.	Construction and mining machinery, n.e.s.	718.100		143											
19.	Mineral crushing machinery, etc.	718.100		330						510	900	480	105		
20.	Heating and cooling equipment	719.100		70	650	115				4227	30	120	65	55	
21.	Pumps and centrifuges	719.100	550	27	240	35	14	25		1875	25	280	120	30	
22.	Mechanical handling equipment	719.200	150	140	240	17	50	15		260	25	300	115	370	175
23.	Powered tools, n.e.s.	719.200	215	16	13	3	12	5		280	5	30	10	430	150
24.	Other non-electrical machines	719.200	110	23	950	100	62	40		665	125	80	25	450	55
25.	Ball, roller or needle-roller bearings	719.200	65	8	36	5	12	7		35	295	15	40	15	275
26.	Machinery and mechanical appliances, n.e.s.	719.200	170	25	520	30	92	52		1810	25	215	35	385	215
27.	Parts and accessories of machinery, n.e.s.	719.200	220	24	320	65	72			1380	30	295	200	245	250
28.	Electric power machinery	722.100	40	60	100	15	50	10	5	430	25	220	10	10	30
29.	Electrical apparatus like autotransformers	722.200		2	54	4	31	10	14	440	25	220	70	10	180
30.	Insulated wire and cable	723.100		4	11	2	10	7	6	100	10	30	5	21	30
31.	Electrical insulating equipment	723.200		1						20		15	5	2	
32.	X-ray apparatus	723.200											4	5	10
33.	Diode, transistors, etc.	723.200	2	1	11	2	6	2	2	35	3	20	6	10	2
34.	Electrical measuring instruments	723.200	11	4	94	10	32	5	4	25	12	50	25	200	110
35.	Electro-mechanical hand tool	723.200	24	3	11	2	3	2		20		10	2	80	5
36.	Electrical accumulators, magnets, furnaces, etc.	723.200	41	12	25	4	19	5	4	70		25	12	35	5
37.	Tests, etc. of iron and steel	723.200	5		58	13		7		30		10	2		
38.	Other tools for use manually or in machine	723.200	233	11	27	2	26	9	9	180	55	35	20	210	100
<b>Total</b>			<b>6600</b>	<b>1200</b>	<b>4800</b>	<b>500</b>	<b>9800</b>	<b>2445</b>	<b>2425</b>	<b>15860</b>	<b>1500</b>	<b>5500</b>	<b>1500</b>	<b>2460</b>	<b>4860</b>



SCHEDULE II

MAIN TABLE OF DISTRIBUTION OF CAPITAL GOODS INVESTMENTS AMONG 15 PRINCIPAL INDUSTRIAL SECTORS

Period A (1976-1980) (1974 prices) (in million pesos)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Sub-total	Remaining activities	Total
	Agriculture	Mining	Food processing	Sugar	Textile & shoe	Pulp & Paper	Printing	Chemical	Cement	Iron & Steel	Non-ferrous metals	Non-electric machinery	Electric machinery	Construction	Electric Power			
								175		5					720	900	-	900
			6				6	110	6	21	11				1800	2050	-	2050
	110	44	71	5				1510	29	43	12	40		240	145	2320	1620	3940
		15	15		15	10	10		15	50	30				1400	1600	-	1600
	334															334	20	354
	1217															1217	-	1217
	14		112													130	-	130
	111	83	13				93	75	55	15			1000	80	5500	1110	6700	
	117		39													155	15	170
	140	10	37	5	7	8		370	15	550	100	2450	1075	142	200	4700	210	6450
										1500	400	710				2710	100	2810
					222			260								880	100	980
					270											282	-	282
																370	460	830
						1030	118									2448	380	2538
						155	270									2425	50	2475
	10		1127													1147	-	1147
		143												3515		3728	100	3828
		330						310	300	490	105			205		2310	270	2580
		70	250	115				1217	30	220	65	55			350	6382	110	6522
	570	87	210	35	24	25		1175	25	230	120	30		410	1190	4880	1000	6290
	110	140	210	17	50	15		260	75	320	115	320	175	510	110	2197	1130	3347
	215	15	13	3	12	5		240	5	30	10	430	150	110	50	1350	1030	2420
	110	23	950	50	20	30		665	125	50	25	450	55	130		2910	940	3860
	25	8	31	5	17	7	35	295	15	40	15	775	560	60	220	2455	1285	3440
	170	25	520	30	92	52	8	1810	25	215	35	885	215	370	160	4150	300	4750
	220	14	30	65	22			1380	30	75	200	745	250	320	650	5234	1370	7204
	40	60	100	15	50	10	5	430	25	220	10	20	30	240	2915	4300	1700	6000
		8	51	4	31	10	14	410	25	220	70	10	180	60	2320	3493	1500	4993
		4	21	2	10	7	6	109	10	30	5	21	30	10	230	484	80	564
		1						10		15	5	2	5		880	928	60	988
											7	5	10	1	10	31	670	701
	2	1	11	2	6	2	2	35	3	20	6	10	10	2	85	157	305	462
	11	4	94	10	32	5	4	257	12	50	25	200	1170	10	125	2107	1485	3592
	24	3	11	2	3	2		20		10	2	80	55	5	20	254	60	314
	41	12	25	4	19	5	4	70		25	12	35	50	10	260	592	1035	1627
	5		50	13		7		30		10	2					183	15	198
	233	11	27	1	26	9	9	180	55	35	10	220	60	160	100	1323	805	2128
	6000	1200	4800	500	9800	2415	2415	15800	1520	5700	1500	2800	4860	9300	14000	56720	24300	115120

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**SCHEDULE I**

**MATRIX TABLE OF DISTRIBUTION OF CAPITAL GOODS IMPORT GROUPS AMONG 13**

Period 1970 - 1974 (1974 prices) (in million)

S.No.	Grouping of capital goods under SIC	Grouping of capital goods according to SITC (4-Digit)	Distribution among 13 groups												
			1	2	3	4	5	6	7	8	9	10	11	12	13
	Name of Group		Agriculture	Mining	Food Processing	Sugar	Textile & Stone	Pulp & Paper	Printing	Chemical	Cement	Iron & Steel	Non ferrous metals	Metallic machinery	Electrical machinery
1.	Steam generating boilers & boiler house plants	711.14								80		21			
2.	Steam engines & gas turbines	711.246		5	5		5	5	5	157	5	20	10		
3.	Internal combustion engines	711.3	117	12	3	2				232	12	12	6		
4.	Engines, n.e.s.	711.8		3	3		3	3	3		3	15	5		
5.	Agricultural machinery for cultivating the soil	712.1	205												
6.	Agricultural machinery for harvesting, etc.	712.2	76												
7.	Milking machines, cream separators, etc.	712.3			53										
8.	Tractors, other than road tractors	712.5	1379	76	2					45	31	23	2		
9.	Agricultural machinery and appliances, n.e.s.	712.9			12										
10.	Mach. tools for working metals	715.1	100	11	19	2	2	4	2	253	2	324	20	24	
11.	Machinering machinery, other than mach. tools	715.2										672	200	104	
12.	Textile machinery	717.1					5824			125					
13.	Machinery for working hides, skins or leather	717.2					190								
14.	Sewing machines	717.3					241								
15.	Paper mill, pulp mill machinery	718.1						1023	60						
16.	Dyeing and finishing machinery	718.2						58	1020						
17.	Food processing machines (excluding domestic)	719.1	12		505										
18.	Construction and mining machinery, n.e.s.	721.1		111											
19.	Mineral crushing machinery, etc.	721.5		257						150	37	205	50		
20.	Heating and cooling equipment	722.1		54	299	54				2012	12	44	34	11	
21.	Pumps and centrifuges	722.2	310	69	101	12	17	11		910	11	121	52	6	
22.	Mechanical handling equipment	722.3	29	110	94	2	34	6		126	31	124	35	74	
23.	Power tools, n.e.s.	722.4	134	13	6	1	2	2		132	2	13	6	12	
24.	Other non-electrical machines	722.5	90	19	144	22	42	21	16	323	53	55	12	20	
25.	Roll, roller or needle-roller bearings	722.2	111	6	12	3	12	3	1	143	6	17	9	27	
26.	Machinery and mechanical appliances, n.e.s.	722.8	101	22	232	11	63	13		877	11	91	12	150	
27.	Tools and accessories of machinery, n.e.s.	722.9	163	66	142	33	53			669	12	329	94	152	
28.	Electric power machinery	723.1	36	46	11	12	35	6	1	122	12	161	57	52	
29.	Electrical apparatus like switches	723.2		6	23	2	21	6	6	222	12	93	35	52	
30.	Insulated wire and cable	723.3		3	5	1	6	3	3	32	2	13	3	6	
31.	Electrical insulating equipment	723.4		1						7		4	1	1	
32.	X-ray apparatus	723.5												2	1
33.	Batteries, inverters, etc.	723.6	1	1	5	1	11	1	1	16	1	2	3	4	
34.	Electrical measuring instruments	723.7	7	3	42	5	22	2	2	124	1	21	11	59	
35.	Electro-mechanical hand tool	723.8	15	2	2	1	2	1		9		4	1	27	
36.	Electrical accumulators, magnets, fuses, etc.	723.9	25	2	11	2	13	2	2	31		11	6	11	
37.	Tools, etc. of iron and steel	725.1	3		25	6		3		47		4	1		
38.	Other tools for use manually or in machine	725.2	143	9	39	4	12	4	4	77	22	14	2	56	
	<b>Total</b>		<b>3710</b>	<b>922</b>	<b>2201</b>	<b>244</b>	<b>672</b>	<b>1198</b>	<b>1153</b>	<b>7110</b>	<b>635</b>	<b>2514</b>	<b>710</b>	<b>2625</b>	



**SCHEDULE 1**

**MATRIX TABLE OF DISTRIBUTION OF CAPITAL GOODS IMPORT GROUPS AMONG 15 PRINCIPAL INDUSTRIAL SECTORS**

Period 1970 - 1974 (1974 prices) (in million pesos)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Sub-total	Remaining activities	Total
	Agriculture	Mining	Food Processing	Sugar	Textile & Shoe	Pulp & Paper	Printing	Chemical	Cement	Iron & Steel	Non-ferrous metals	Non-machine machinery	Electric machinery	Construction	Electric Power			
711.140								80		24					400	501	-	501
711.340		5	5		5	5	5	157	5	20	10				1570	1787	-	1787
711.5	112	12	2	2				732	10	22	6	2		132	60	2147	1000	3147
711.8		3	3		3	3	3		3	15	5				240	278	-	278
712.1	205															100	100	100
712.2	70															70	70	70
712.3			53													66	66	66
712.5	1310	70	8					45	31	23	2			1658	34	2202	50	2252
712.9			12													84	84	84
713.1	15	11	19	2	2	4	5	253	7	375	80	244	244	92	132	2157	1000	3157
713.2										672	208	104				984	50	1034
713.7					5924			125								6049	200	6249
713.8					190											190	190	190
713.9					244											244	244	244
718.1						1053	60									1082	1000	2082
718.2						69	1026									1095	1000	2095
718.3	10		585													595	500	1095
718.4		112												1787		2095	1000	3095
718.5		257						150	327	205	51			114		2140	1000	3140
719.1		54	202	54				2012	12	149	34	11			140	2220	1000	3220
719.2	341	92	101	12	17	11		910	11	121	52	5		202	576	2122	1000	3122
719.3	20	110	94	2	34	6		126	31	121	55	24	56	222	12	1170	1000	2170
719.4	134	13	6	1	2	2		137	2	11	6	22	53	62	12	547	1000	1547
719.5	90	18	144	22	42	24	16	323	53	35	12	96	14	22		1545	1000	2545
719.6	11	6	12	3	12	3	1	143	6	12	8	152	111	35	93	724	500	1224
719.7	101	12	237	12	63	13		879	11	91	12	156	20	204	64	1902	1000	2902
719.8	463	66	117	33	53			660	12	329	94	152	82	140	293	2204	1000	3204
722.1	36	46	12	12	35	6	2	228	12	161	52	52	23	122	1955	2322	500	2822
722.2		61	23	2	21	6	6	212	12	91	35	52	52	35	912	1522	1000	2522
723.1		3	5	1	6	3	3	32	2	13	3	6	9	5	100	192	100	292
723.2		1						7		4	1	1	3		432	401	50	451
723.3											2	1	4	1	3	44	300	344
723.4	1	1	5	1	4	1	1	16	1	2	3	4	6	1	11	64	100	164
723.5	7	3	42	5	22	2	2	124	11	21	11	52	262	11	53	724	700	1424
723.6	15	2	8	1	2	1		9		4	1	22	38	3	2	119	100	219
723.7	25	9	11	2	13	2	2	34		11	5	11	12	6	112	254	500	754
723.8	3		25	6		3		44		4	1					60	100	160
723.9	143	9	32	4	12	4	4	72	22	14	2	55	66	81	44	540	1000	1540
	3710	924	2211	244	6215	1198	1133	7410	635	2511	710	2525	1155	5365	7324	48731	1000	49731

**SCHEDULE III**

**MATRIX TABLE OF DISTRIBUTION OF CAPITAL GOODS INTO GROUPS AMONG 15 PRINCIPAL**

Period B (1981 - 1985) (1974 prices) (in million peso)

Pos.	Grouping of Capital Goods acc. to SITC	Grouping of capital goods according to SITC Number.															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Name of Group			Agriculture	Mining	Food Processing	Sugar	Textile & Shoe	Pulp & Paper	Printing	Chemical	Cement	Iron & Steel	Iron / ferrous metals	Non-ferrous metals	Non-electric machinery	Electric machinery	
1.	Steam generating boilers & boiler house plants	711.102								215		35					
2.	Steam engines & gas turbines	711.206		9	9		9	9	9	200	9	36	20				
3.	Internal combustion engines	711.3	340	53	41	6				2965	55	70	46	67			
4.	Engines, n.e.c.	711.8		20	20		20	20	20		20	97	33				
5.	Agricultural machinery for cultivating the soil	712.1	415														
6.	Agricultural machinery for harvesting, etc.	712.2	150														
7.	Milking machines, cream separators, etc.	712.3	30		160												
8.	Tractors, other than road tractors	712.4	2625	145	25					180	180	90	25				
9.	Agricultural machinery and appliances, n.e.c.	712.9	450		50												
10.	Mach. tools for working metals	713.1	80	30	50	5	20	12	6	650	17	323	137	180	200		
11.	Machinering machinery, other than mach. tools	713.2										2550	610	270			
12.	Textile machinery	717.1					12700			505							
13.	Machinery for working hides, skins or leather	717.2					410										
14.	Sewing machines	717.3					510										
15.	Paper mill, pulp mill machinery	718.1							3525	192							
16.	Printing and bookbinding machinery	717.2						240	3345								
17.	Food processing machines (excluding domestic)	718.3	35		1791												
18.	Construction and mining machinery, n.e.c.	718.4		210													
19.	Mineral crushing machinery, etc.	718.5		420						605	1505	280	170				
20.	Heating and cooling equipment	719.1		105	225	175				2735	50	245	90	90			
21.	Pumps and centrifuges	719.2	672	430	305	55	35	40		3680	45	200	170	50			
22.	Mechanical handling equipment	712.3	160	210	285	25	75	20		590	130	510	180	630	350		
23.	Powered tools, n.e.c.	719.4	270	25	25	3	20	10		555	10	50	20	210	350		
24.	Other non-electrical machines	719.8	425	25	135	25	100	75	50	1305	220	150	35	780	210		
25.	Ball, roller or needle-roller bearings	719.7	25	10	50	10	25	10	5	570	25	55	25	1335	100		
26.	Machinery and mechanical appliances, n.e.c.	719.9	220	35	705	60	145	40		3555	45	345	50	1210	450		
27.	Parts and accessories of machinery, n.e.c.	719.9	300	125	445	110	121			2705	50	1250	280	1225	515		
28.	Electric power machinery	722.1	180	200	350	45	150	20	10	1125	60	600	260	200	200	80	
29.	Electrical apparatus like switches, etc.	722.2		10	70	5	45	20	20	240	50	350	105	490	360		
30.	Insulated wire and cable	722.1		5	15	3	10	10	10	150	10	50	10	50	55		
31.	Electrical insulating equipment	722.2		3						20		12	3	3	9		
32.	X-ray apparatus	722.2												5	10	25	
33.	Photocell, transistors, etc.	722.2		2	9	3	10	5	3	65	4	30	10	35	40		
34.	Electrical measuring instruments	722.2		6	120	15	50	7	7	500	15	20	20	500	230		
35.	Electro-mechanical hand tool	722.2		4	25	3	5	5		35		15	3	230	240		
36.	Electrical accumulators, magnets, fuses, etc.	722.2		5	17	35	6	20	7	110		40	20	90	105		
37.	Tools, etc. of iron and steel	722.2		6	75	21		10		420		15	3				
38.	Other tools for use manually or by machine	722.2		20	120	15	40	15	15	310	90	50	30	465	410		
<b>Total</b>			<b>7600</b>	<b>1900</b>	<b>7000</b>	<b>200</b>	<b>24000</b>	<b>4000</b>	<b>5700</b>	<b>50900</b>	<b>2500</b>	<b>7000</b>	<b>2300</b>	<b>1100</b>	<b>2400</b>		





**SCHEDULE III**

**MATRIX TABLE OF DISTRIBUTION OF CAPITAL GOODS IMPORT GROUPS AMONG 15 PRINCIPAL INDUSTRIAL SECTORS**

Period B (1981 - 1985) (1974 prices) (in million pesos)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Sub-total	Remaining articles	Total
	Agriculture	Mining	Food Processing	Sugar	Textile & Shoe	Pulp & Paper	Printing	Chemical	Cement	Iron & Steel	Non-ferrous metals	Non-electric machinery	Electric machinery	Construction	Electric Power			
711.1.1								215		35					1080	1350	-	1350
711.3.6		9	9		9	9	9	100	9	36	10				2700	3100	-	3100
711.5	240	57	11	5				1965	55	70	16	57		200	170	4017	6510	10500
711.8		20	20		20	20	20		20	97	33				2500	2750	-	2750
712.1	415															415	20	435
712.2	1510															1510	-	1510
712.3	30		160													190	-	190
712.5	1625	145	25					180	100	90	25			2000	30	5150	4200	9350
712.9	450		50													200	25	225
713.1	80	30	50	5	20	12	5	650	17	223	137	1400	700	240	300	5280	4800	10080
713.2										2150	610	280				14030	165	14165
717.1					12700			505								13205	750	13955
717.2					410											410	-	410
717.3					500											500	500	1000
718.1						3585	192									3777	600	4377
718.2						240	3340									3580	500	4080
718.3	25		1791													1816	-	1841
718.4		210												5700		5910	300	6210
718.5		430						605	1500	200	150			230		3925	410	4335
719.1		105	285	175				1735	20	245	90	90			300	10235	-	10335
719.2	692	130	305	55	35	40		3680	45	400	170	50		680	1310	7632	300	7932
719.3	160	210	285	25	75	20		510	130	510	120	630	350	215	120	4000	1300	5300
719.4	270	25	25	3	20	10		555	10	50	20	210	350	120	20	2333	120	2453
719.5	485	25	135	235	100	75	50	1305	220	150	25	700	210	210		4205	1050	5255
719.7	85	10	50	10	25	10	5	500	25	35	25	1335	174	120	240	3705	2000	5705
719.8	220	35	205	60	145	20		355	45	345	50	1250	440	520	105	7781	5000	12781
719.9	320	125	445	110	121			2705	50	1252	280	1225	515	500	70	7122	3000	10122
722.1	100	200	350	45	150	20	10	1125	60	600	200	200	801	650	4330	8200	1400	9600
722.2		10	70	5	45	10	20	940	50	350	105	490	360	100	2560	5725	240	6025
722.3		5	15	3	10	10	10	150	10	50	10	50	55	15	200	653	100	753
722.4		3						20		12	3	3	9		1280	1430	100	1510
722.5	1										5	10	25	5	10	57	1025	1140
723.1	1	1	17	3	10	5	3	85	4	30	10	35	40	5	30	258	500	758
723.2	44	6	120	15	50	7	7	500	15	20	30	500	2300	30	140	2824	2400	5224
723.3	30	4	25	3	5	5		35		15	3	230	240	9	20	624	95	719
723.4	5	17	25	6	20	7	7	110		20	20	90	105	20	220	653	1000	1653
723.5	6		25	21		10		120		15	3					310	10	320
723.6	200	17	120	15	40	15	15	310	90	50	30	465	400	255	115	2237	1200	3437
	7600	1900	7020	200	14600	4800	5700	20900	1800	9000	2300	11400	7400	25000	19000	130800	5000	135800

**SECTION 2**

SCHEDULE IV

CAPITAL GOODS IMPORT GROUPS AT 1974 SITC LEVEL FOR PERIODS A AND B  
(MILLION PESOS 1974 PRICES)

Pos.	Name of Group	Grouping of capital goods according to SITC Manual	Imports 1970-74 (ex-man)	Imports 1976-80	Imports 1981-85	Imports 1976-85
1.	Steam generating boilers	711.1		300		2250
2.	Boiler house plant	711.2	501	2050		5150
3.	Steam engines & Gas turbines	711.3 & 711.6	1787	6306		16939
4.	Internal combustion engines	711.5	3164	1600		4350
5.	Engines, n.e.s.	711.8	278	331		796
6.	Agricultural machinery for cultivating the soil	712.1	233	415		2737
7.	Agricultural machinery for harvesting, etc.	712.2	746	1217		329
8.	Drilling machines, cream separators, etc.	712.3	66	139		160
9.	Tractors, other than wind tractors	712.5	3763	6707		16677
10.	Agricultural machinery and appliances, n.e.s.	712.9	97	170		375
11.	Machining tools for working metals	713.1	3790	6850		16110
12.	Machining machinery, other than mach. tools	713.2	1034	2819		7011
13.	Textile machinery	717.1	6284	9323		23114
14.	Machinery for working hides, skins or leather	717.2	190	282		612
15.	Sewing machines	717.3	478	828		2112
16.	Paper mill, pulp mill machinery	718.1	1280	2519		6315
17.	Printing and bookbinding machinery	718.2	1769	3005		7539
18.	Food processing machines (excluding domestic)	718.3	67	1147		4525
19.	Construction and mining machinery, n.e.s.	718.4	2202	3949		10229
20.	Metal crushing machinery, etc.	718.5	1284	2590		6970
21.	Logging and cutting equipment	719.1	2766	6522		15757
22.	Pumps and centrifuges	719.2	3363	6790		17522
23.	Mechanical handling equipment	719.3	1367	3317		6727
24.	Powered tools, n.e.s.	719.5	1091	2429		6502
25.	Other non-electrical machines	719.6	1791	3461		10175
26.	Roll, roller or screw-roller bearings	719.7	1376	3140		5231
27.	Machinery and mechanical appliances, n.e.s.	719.8	3077	7708		26097
28.	Tools and accessories of machinery, n.e.s.	719.9	3268	7204		18632
29.	Electric power machinery	722.1	2133	4952		12513
30.	Electrical appliances like air-conditioners	722.2	237	544		1382
31.	Insulated wire and cable	723.1	239	544		788
32.	Electrical insulating equipment	723.2	409	928		1570
33.	X-ray apparatus	724.2	310	761		2319
34.	Photocell, transistors, etc.	729.3	219	572		1841
35.	Electrical measuring instruments	729.5	1497	3202		1220
36.	Electro-mechanical hand tool	729.6	149	314		6234
37.	Electrical accumulators, magnets, fuses, etc.	729.9	908	1667		719
38.	Tools, etc. of iron and steel	802.11	95	196		2928
39.	Other tools for use manually or in machine	802.12	573	2120		455
	TOTAL IMPORTS '77		5679	21520		5570
	NON IDENTIFIED		30371	113700		290729
	GRAND TOTAL IMPORTS '77		36050	135220		185100
			57029	167500		275809

**SCHEDULE IV**  
**CAPITAL GOODS IMPORT GROUPS AT 4 UNIT SITC LEVEL FOR PERIODS A AND B**  
**(MILLION PESOS 1974 PRICES)**

Pro.	Name of Group	Grouping of capital goods according to SITC Number	Imports 1976-74 (actual)	Imports 1976-80	Imports 1981-85	Imports 1976-85
1.	Steam generating boilers	711.1				
2.	Boiler house plant	711.2	501	970	1359	2230
3.	Steam engines & Gas turbines	711.3 & 711.6	1797	2030	3100	5139
4.	Internal combustion engines	711.5	3164	6546	10572	16988
5.	Engines, n.e.s.	711.8	279	1609	2750	4530
6.	Agricultural machinery for cultivating the soil	712.1	213	351	415	736
7.	Agricultural machinery for harvesting, etc.	712.2	746	1217	1350	2717
8.	Milking machines, cream separators, etc.	712.3	66	179	199	329
9.	Tractors, other than road tractors	712.5	3758	6707	5970	16677
10.	Agricultural machinery and appliances, n.e.s.	712.9	37	170	215	395
11.	Machining tools for working metals	713.1	3706	6850	9510	16710
12.	Machining machinery, other than mach. tools	713.2	1031	2819	4198	7014
13.	Textile machinery	717.1	6281	9323	14073	23334
14.	Machinery for working hides, skins or leather	717.2	190	232	416	672
15.	Power mill, pulp mill machinery	717.3	473	832	1281	2112
16.	Printing and bookbinding machinery	719.1	1270	2519	4178	5915
17.	Food processing machinery (excluding domestic)	719.2	1340	3095	4525	7539
18.	Text processing machinery (excluding domestic)	719.3	207	1147	1816	2913
19.	Chemical processing machinery, n.e.s.	719.4	2402	3748	6380	10223
20.	Animal crushing machinery, etc.	719.5	1294	2090	3050	4920
21.	Blowing and cooling equipment	719.8	2706	6022	10245	14737
22.	Pumps and centrifuges	719.9	3403	6770	10732	17552
23.	Mechanical hoisting equipment	719.3	1567	3217	5037	8527
24.	Power tools, n.e.s.	719.5	1693	3239	4973	8393
25.	Other non-electrical machines	719.6	1794	3531	5335	9084
26.	Ball roller or needle roller bearings	719.7	1256	3449	5741	9571
27.	Machinery and mechanical appliances, n.e.s.	719.9	3067	7797	12381	20307
28.	Tools and accessories of machinery, n.e.s.	719.9	3268	7251	11389	18902
29.	Electric power machinery	722.1	329	670	969	1505
30.	Electrical appliances like switchgears	722.2	233	413	755	1234
31.	Insulated wire and cable	723.1	259	574	789	1312
32.	Electrical insulating equipment	723.2	489	988	1510	2518
33.	X-ray apparatus	726.2	550	791	1170	1911
34.	Photo-cell, transistors, etc.	726.3	319	582	785	1229
35.	Electrical measuring instruments	729.5	1387	312	528	856
36.	Electro-mechanical hand tool	729.6	149	314	479	793
37.	Electrical accumulators, magnets, furnaces, etc.	729.12-91.72.36.96	298	1667	2828	4595
38.	Tanks, etc. of iron and steel	622.21	93	193	330	553
	Other tools for use animals or in machine	625.2	373	216	342	570
	<b>TOTAL (IMPORTS "A")</b>		<b>85779</b>	<b>125720</b>	<b>173200</b>	<b>249230</b>
	<b>NON IDENTIFIED</b>		<b>37321</b>	<b>71780</b>	<b>113300</b>	<b>183180</b>
	<b>GRAND TOTAL (IMPORTS "A")</b>		<b>123100</b>	<b>197500</b>	<b>286500</b>	<b>432410</b>

#### IV. POSSIBILITIES FOR MANUFACTURING HEAVY ELECTRICAL EQUIPMENT IN MEXICO

9.1 In terms of projected imports, rapid growth potential and technological development needs, an accelerated expansion in the manufacture of heavy electrical equipment in Mexico is an essential need. Though, over the last decade, there has been considerable increase in the manufacture of transformers, particularly distribution transformers, electric motors upto 1000 hp, switchgear and control equipment besides porcelain insulators upto 34.5 kv, the demand for power generation and heavy electrical equipment in the higher ranges has risen very rapidly and is likely to constitute a major production gap.

The manufacture of most heavy electrical equipment involves relatively heavy capital expenditure as also long gestation periods, and it is imperative that the programming of such manufacture is undertaken with great care and urgency. The growth of installed capacity in electricity generation in Mexico has been fairly rapid over the last decade as can be seen from the Table below:

TABLE IV

Growth of Installed Capacity \*

	<u>1963</u>	<u>1966</u>	<u>1969</u>	<u>1972</u>	<u>1973</u>
Total installed capacity (in MW)	4.2	5.68	6.98	8.11	9.06
Installed capacity in public services (CFE) (in MW)	3.37	4.89	5.87	7.308	8.08
Apparent consumption (in Gwh)	14.36	19.08	25.60	2.07	37.90
Electricity generation through public services (in Gwh)	10.96	15.82	21.84	31.50	33.98

\* Data from "Economía Mexicana"

9.2 By 1974, the total generating capacity of the Comisión Federal de Electricidad (CFE) was 8207.7 MW. Of this, hydro-electric power represented 3553 MW, oil and gas-fired stations constituted 4311 MW, diesel power was of the order of 231.2 MW. The CFE has made detailed

projections of likely installed capacity for the period upto 1982 and this may be seen in the Table below:

TABLE No. V

<i>Installed Capacity (MW)</i>	<i>1974</i>	<i>1975</i>	<i>1976</i>	<i>1977</i>	<i>1978</i>	<i>1979</i>	<i>1980</i>	<i>1981</i>	<i>1982</i>
<i>Hydro</i>	3552.9	3942.9	4348.9	4708.9	5068.9	5968.9	8068.9	8918.9	9068.9
<i>Diesel</i>	231.2	250.8	199.7	205.7	205.4	205.7	205.4	205.7	205.7
<i>Geothermic</i>	75.0	75.0	75.0	150.0	180.0	235.0	270.0	345.0	400.0
<i>Thermal</i>									
<i>Oil</i>	3243.3	4255.8	4416.3	5968.8	6906.3	7206.3	7581.3	7956.3	8856.3
<i>Coal</i>	37.5	37.5	37.5	357.5	357.5	357.5	657.5	957.5	957.5
<i>Nuclear</i>	-	-	-	-	654.0	1038.0	1038.0	1038.0	1038.0
<i>Gas</i>	1067.8	1319.8	1335.8	1335.8	1335.8	1349.8	1349.8	1349.8	1363.3
<i>Total</i>	8207.7	9881.7	10413.2	12726.7	14708.2	16631.2	19461.2	21041.2	22160.2

9.3 For the period after 1982, considerable planning and review has been done in the light of the latest economics of energy production. From the latest figures as indicated by CFE, it is projected that total power generation would increase to 27,000 MW in 1985, 42,000 MW by 1990, 60,000 MW by 1995 and 85,000 MW by the year 2000. Of this, the main emphasis is presently being placed on hydro-electric power, which is projected to increase from 3,900 MW in 1975 to 16,400 MW in 1990 and 23,300 by the year 2000. Hydro-electric power is projected to increase from 35.4% of total capacity to 49.3% by 1985 and thereafter fall to around 33.9% by 1995. These figures clearly indicate that, demand for power generation and distribution equipment would continue to grow rapidly during the next 10-year period and thereafter. This, in turn, would obviously constitute a very strong base for a greatly expanded programme for heavy electrical equipment manufacture in the country. In the subsequent paragraphs, a brief analysis is given of present production, projected demand and manufacturing potential, together with investment promotion results and recommendations in respect of: (i) power transformers, (ii) high-voltage circuit breakers, (iii) motors and generators, (iv) porcelain insulators, (v) hydro-turbines and (vi) high-pressure boilers for power

stations. More detailed data regarding market projections etc. is available in the pre-investment studies for each of these subsectors, but some of the information indicated below includes the latest updating, together with the present situation regarding the promotion of specific manufacturing projects in these branches.

9.4 From the projections in Chapter III the likely imports of some of the principal items of heavy electrical equipment are briefly summarised in the Table below:

TABLE No. VI      In million pesos (1974 prices)

<u>SITC No.</u>	<u>Description</u>	<u>Projected Imports in 1976 - 80</u>	<u>Projected Imports in 1981 - 85</u>
722.1	Electric power machinery, including generators, motors (above 220 kg) other rotating equipment, static transformers, convertors and static reactors.	6,000	9,600
722.2	Electrical apparatus, including circuit breakers, switchgear, relays, lighting arrestors, control and distribution boards, etc.	4,993	7,555
723.2	Electrical insulating equipment, principally porcelain insulators.	988	1,530
729.5	Electrical measuring instruments.	3,592	6,234

9.5 Together with high-pressure boilers for power stations, the above group of electrical machinery products represent a significant production gap in the Mexican economy. These figures do not include import estimates for insulated wires and cables and for other electrical items, in respect of which gap would be relatively small and where domestic production is likely to expand so as to cover increased domestic demand as also export possibilities.

### POWER TRANSFORMERS

10.1 There are over 15 companies making "distribution transformers" in small sizes upto 750 kVA. Of these, the following five units manufacture power transformers as well:

1. *Industria Eléctrica de México (IEM).*
2. *Industrial Eléctrica.*
3. *Ingeniería Eléctrica Industrial.*
4. *Manufacturera de Artefactos Eléctricos.*
5. *Maquinaria Continental Eléctrica.*

10.2 Of these, IEM is the largest manufacturer and is producing, among other electrical products, medium and large power transformers in sizes upto 100 MVA and 230 kV but only a small number of the larger size units. The next two units listed above have recently undertaken the manufacture of a few transformers upto 15 MVA while the fourth and fifth units listed are manufacturing in the range upto 5 MVA and in voltages up to 69 or 115 kV. All the companies are of fairly long standing and, with the exception of IEM, their facilities are limited and not really well equipped for medium and large transformers. Most of the companies have a satisfactory order book in their respective product ranges and unless substantial expansion and modernisation take place, they will not be in a position to cope with increased demand. However, with a certain amount of marginal expansion to maintain some sales growth, these companies could, by and large, meet the total demand in sizes upto 25 MVA for voltages upto 115 kV. The principal production gap is therefore, likely to emerge in respect of transformers from 30 MVA to the highest sizes in demand of about 150 MVA and in voltages of 115, 230 and 400 kV. In this range, the approximate aggregate demand was about 5500 MVA in 1974 and of this, only 2000 MVA of power transformers (mostly of medium size and a few of large size) was produced in Mexico by IEM while the remaining quantity was imported. The pre-investment study by an UNIDO expert with the assistance of NAFINSA estimated demand for this range to reach 7500 MVA by 1980, 9500 MVA by 1985 and 14,500 MVA by 1990. In view of the significant production gap that is likely to emerge, it was recommended in the UNIDO pre-investment study (1974), that additional manufacturing capacity to the extent of 4000 MVA needed to be established by 1980, increasing to 7000 MVA by 1985. It is expected that with such additional capacity, total imports will be brought under 10% (limited to highly sophisticated and uneconomical items only) and a large measure of self-sufficiency will be achieved. At the same time, upto 10% of an even higher percentage of total production could also be exported, mostly in the medium range which would get fully established within a few years after commencement of manufacture.

10.3 In order to highlight the techno-economic aspects of the above additional manufacturing capacity, the pre-investment study had conceived a single new project, with projected output of 4000 MVA (Stage I) and 7000 MVA (Stage II). The product mix was provided having regard to the most common types and sizes in demand:

TABLE No. VII

<u>Transformer Project</u>	<u>Stage I (1982)</u>	<u>Stage II (1987)</u>
<u>Group I - very large</u>	1250 MVA	3500 MVA
<u>Group II - large</u>	1500 "	2000 "
<u>Group III - medium</u>	1250 "	1500 "
<b>Total</b>	<b>4000 "</b>	<b>7000 "</b>

10.4 The capacities in Stage II are inclusive of those in Stage I. Besides, provision has been made for a substantial production of certain complementary auxiliary items and essential components such as condenser bushings and on-load tap changers, and instrument transformers upto 400 kV, for which the existing production capacity in Mexico is inadequate. A total sale value of 240 million pesos was projected for 1982 (Stage I) and 375 million pesos (Stage II) at 1974 prices. The pre-investment study also recommended that the location of the plant should be away from Mexico City and should be located at an adjoining medium-size town in the central region of Mexico, such as Puebla or in the Querétaro-San Luis Potosí area. The factory would require a fairly large and exclusive area, heavy factory bays and all associated facilities such as heavy and medium cranes (50--150 tons), adequate power supply (3000 kW, increasing to 5000 kW), railway siding, heavy load-bearing internal roads, and modern process and test equipment, etc. The total estimated cost in the pre-investment study was assessed at 120 million pesos for land and civil constructions and 160 million pesos for machinery and equipment of all types, of which the foreign exchange portion amounted to 96 million pesos. In addition, preliminary expenses for training, technology, construction, and interest during construction was estimated at 30 million pesos. Thus, the total investment for Stage I amounted to 310 million pesos. This would increase to 380 million pesos in Stage II (30 million for civil works and 40 million pesos for equipment). Import content in the first few years would amount to 37.5% of the total cost of all materials or about 15% of the sale value of a transformer. Such a project is expected to provide employment for over 800 people, of which 500 would be technical personnel (including skilled and semi-skilled artisans). The financial results, in terms of cash flow, saving of foreign currency and value-added indicate that the project could meet all operating expenses, including interest on working capital as well as loan capital from the fourth year onwards, breaking even



*in the fifth year, followed by improved results thereafter. During the life of the project, from 1978 to 2002 the following benefits will be derived:*

- (i) Cumulative financial resources generated = 1733 million pesos*
- (ii) Total savings in foreign exchange = 6200 " "*
- (iii) Total value added = 2790 " "*

*Investment propositions*

*10.5 Though the pre-investment study had conceived of a single large new project, the progress of investment promotion has followed a somewhat different pattern. The first proposal, which has been under consideration for some time, envisages a substantial expansion in the facilities of IEM, with an additional capital investment of around 80 million pesos. With such expansion, the Company propose to extend their range of production to include 400 kV and also to increase the volume of annual output of medium and large power transformers. This is obviously a desirable proposition though it may have been preferable if IEM had set up a completely new facility away from their present factory site. Since this company has access to Westinghouse technology, it is technologically well-equipped to undertake an even larger expansion than contemplated by the company at present. A second proposal has been mooted by one of the companies making distribution and small power transformers, Manufacturera de Artefactos Eléctricos, who are considering the establishment of a new transformer plant to cover the range upto 230 kV. This proposal was discussed in a preliminary form with the UNIDO-NAFINSA Group and a detailed proposal was thereafter awaited. The company has had discussions with a number of reputed European companies for obtaining technological assistance and licensing and it is expected that they would take a final decision in this regard fairly shortly. It is envisaged that the additional capital investment may be of the order Ps 150 million in 2-3 phases. As soon as the licensing arrangements are concluded, it is expected that a formal proposal would be received for NAFINSA participation and financial assistance for this proposal. This investment proposition is designed to cover about 40% of the domestic market in medium and large-size transformers upto 230 kV. A third proposal, which is tentatively under consideration in the CFE is that of an Italian company which has proposed the establishment of a major new transformer plant with a total initial investment of million pesos. The proposal had been submitted in a preliminary form to NAFINSA earlier and had been examined by the Group at one stage. However, the present proposal is understood to have been revised considerably.*

10.6 Without a detailed examination of the proposals of the Italian company, it is not practicable to make a comparative assessment of the 3 proposals. It is clear, however, that the proposals of major expansion of the two existing enterprises deserve the fullest support. The two expansion projects would cover the gap in domestic production substantially by 1980 and, in view of the high projected demand, both expansion projects should prove to be quite successful. This would still leave room for marginal or even substantial expansion of one or other of the remaining smaller manufacturers of transformers within the country. Consequently, the pattern and strategy for new investments in the manufacture of transformers could be to (a) encourage and financially assist IEM's expansion proposal but carefully assess their capability in terms of numbers and sizes for the next five years and ensure that adequate test equipment and procedures are incorporated as an integral part of the expansion and (b) encourage Manufacturera de Artefactos Eléctricos to set up a new plant, even with a limited scope, to cover transformers in the range of say, 10 to 80 MVA for voltages upto 230 kV. This would help in the sharing of the demand by the two companies, IEM moving to large and very large sizes in 230 and 400 kV, while the other unit could concentrate on medium and large sizes in 115 and 230 kV. Over the next ten years, the second company could also cover the entire range, which would bring about healthy competition and near self-sufficiency.

#### High Voltage Circuit Breakers

11.1 A preliminary pre-investment study on the manufacture of high voltage circuit breakers and allied equipment to cover the voltage range of 14 kV to 400 kV and the interrupting ratings required by the Mexican power system of the CFE, was prepared by an UNIDO expert in May 1975. This study pointed out that there are a few small companies which are presently manufacturing some of the equipment in the lower voltage ranges for industrial applications, but import most of the key components. Only one large company has been attempting to make some of the medium level circuit breakers upto 69 kV but even this has not made much progress. The entire range of circuit breakers in the higher voltages such as 115, 230 and 400 kV, are being imported. In view of the sophisticated nature of the high voltage circuit breakers and the high level of investment required, it is considered that the creation of a single manufacturing outfit specializing in one, or preferably two, of the alternative types of technology, would appear to be the right approach and would result in economy in investment and operating costs. The gap in local production would necessarily have to be covered by a single facility and phasing the investment as production grows and the level of national integration increases.

11.2 There are four common types of high voltage circuit breakers,

namely bulk oil, minimum oil, air-blast and sulphahexafluoride, (SF<sub>6</sub>) of which the first is gradually going out of use while the last appears to be most recent and up-coming. The CFE is using the three types (except bulk oil) and these three types are quoted near competitively in the market.

All the three types require considerable amount of high quality electrical porcelain which will have to be imported for a number of years, until these are manufactured in Mexico. In the pre-investment study, the demand for H.V. circuit breakers (from 60 kV to 400 kV) was been estimated at a value of 115 million pesos, which is an average figure for 1975 to 1980 while the corresponding figure for 1981-85 would be 177 million pesos. In addition, certain demand would exist for H.V. isolators in the same voltage class and also for special circuit breakers and switchgear in the voltage ranges of 34.5, 23, 14 and 6 kV. and the new production facilities could cover all these items.

11.3 During 1975, the demand projections for circuit breakers was revised and updated by the NAFINSA engineers in the Group. The revised demand projections are as follows:

**TABLE No. VIII**  
**DEMANDA DE INTERRUPTORES DE POTENCIA**

Descripción	Unidades						
	1975	1976	1977	1978	1979	1980	
<b>Tensión KV</b>	<b>Capacidad interruptiva MVA</b>						
69	1500-2500	50	55	60	67	73	81
115,138	5000	323	355	389	427	468	514
161,230	5000	56	62	68	74	82	90
400		51	64	58	62	66	71
<b>T o t a l</b>		<b>480</b>	<b>536</b>	<b>575</b>	<b>630</b>	<b>689</b>	<b>756</b>

**NOTAS:**

1. Cifras reales para 1975 de acuerdo con presupuesto de obras de la C.F.E. y C. de L. y F.C. en liquidación.
2. No se incluye la demanda de usuarios industriales que puede llegar a un 10% (Pemex, Minería, Química, etc.)
3. Las cifras para 1976, 1977, 1978, 1979 y 1980 se proyectaron considerando un aumento del 10% anual (La generación aumenta en un 13%).

The manufacturing facilities required would depend upon the type of circuit breaker selected for production and also the special techniques followed by the company supplying the technology.

### Investment proposals

11.4 The UNIDO-NAFIN Group wrote to a number of reputed European manufacturers in mid 1974, inviting project proposals for the manufacture of H.V. circuit breakers. During the period from Sept. 74 to March 75, three proposals were received from 3 reputed manufacturers from FRG, France and Switzerland. Two of the companies proposed to take up sulphur-hexafluoride (SF<sub>6</sub>) type for 115, 230 and 400 kV systems while the third company proposed sulphur-hexafluoride type for 110 kV only and air-blast type for 230 and 400 kV. These proposals have been studied and appraised by the Group and final discussions and negotiations are being held by NAFINSA, in consultation with CFE. It is anticipated that the capital investment on this new project would be of the order of 60 million pesos and production capacity would cover at least 75% of projected domestic market. An important issue relates to a guaranteed volume of orders from CFE at prices which would enable the project to become viable within a reasonable period of time. It would obviously be difficult for CFE to accept any pricing formula which would result in prices of domestically produced breakers being higher than international prices plus the margin of 15% normally allowed for domestic producers even on IBRD tenders. Any pricing above this figure would need to be covered by special financial incentives.

### Electric Motors and Generators

12.2 A pre-investment study on electric motors and generators was completed in April 1975. The scope of the study covered the following product classification:

#### (i) A.C. Motors

- a. Squirrel cage induction motors (201 to 10,000 HP)
- b. Wound rotor (or slip-ring) induction motors (21 to 10,000 HP)
- c. Synchronous motors (21 to 10,000 HP).

#### (ii) D.C. Motors

- a. Industrial type                      21 HP to 2,000 kW.
- b. Rolling mill type                    501 HP to 10,000 kW.
- c. Traction type                        100 kW to 1,000 kW.

(iii) A. C. Generators (21 kW to 10,000 kW)

*Industrial type driven by diesel engines, gas turbines or steam turbines.*

(iv) D. C. Generators (21 kW to 10,000 kW)

*In view of the fact that the existing manufacturers in Mexico are already producing almost all the requirements of A. C. squirrel cage induction motors upto 200 HP, the minimum size for this item was taken as 201 HP, and the smaller sizes were excluded from the scope of this study. A small part of the demand in the range 201 to 1250 HP of A. C. squirrel cage motors (item (i) above) is being met by three of the existing motor manufacturers. Besides, two companies are producing A. C. generators upto 200 MW (item (ii) above). Most of the other types and sizes of motor and generators are being manufactured as at present and these requirements are covered by imports.*

12.2 In view of the large variations in the use of electric motors over a wide spectrum of industry and the absence of systematic data on internal production, imports, etc., the preparation of demand projections proved to be a difficult task. A direct approach had to be made to major industries to ascertain, by discussions, their future plans, projections and the technical practice followed by them in the use of electric motors. Some export data published by the "U.S. Department of Commerce, Bureau of the Census" have been of some limited use. By putting together all relevant information, however, a fairly realistic assessment of demand as of 1950 was able to be made. Further projection upto 1985 has been made by applying a 9% rate of growth in line with the energy growth rate of the CFE. Contacts were also made with 12 major industry groups, the important ones being PEMEX, CFE, Hydraulic Resources Dept. and the Railways (diesel-electric), and suburban transport systems, besides major industries such as steel, cement, sugar, pulp and paper, mining, chemicals, etc. Fairly accurate data on motor and generator requirements was provided by Petróleos Mexicanos (PEMEX) for their wide range of activities. An important item of demand refers to motors and generators for drilling rigs, the manufacture of which has now been initiated in Mexico. The CFE also furnished fairly detailed data on their need of large and medium motors and auxiliary drives for the next six years. The Hydraulic Resources Dept. also indicated some approximate data on their future demand against major projects. The diesel-locomotive manufacturing project (CNCF) may require substantial quantities of A. C. generators and D. C. motors for their projected programme starting with 40 locomotives in 1976 increasing to 60 in 1980. The organisation for the underground urban transport (Metro) in Mexico City also indicated their requirements for their future expansion

plans. Reasonable assumptions were also able to be made in respect of the steel, cement, sugar, paper, chemical and mining industries. Demand of a general nature from Social Security Department, and all other industries such as construction, heavy engineering and other industries was assessed in an overall manner, as a percentage of the aggregate demand of the specific industries. In addition to the range of 200-10,000 HP/kW motors and generators included in the above items, an overall assessment of motors below 200 HP (of types not being made in Mexico) was also made on the basis of export statistics of the U.S. Department of Commerce. This excludes local production of A.C. squirrel cage motors in this range, which is nearly self-sufficient.

12.3 The final assessment of the market for motors and generators emerged as follows in the pre-investment study:

**TABLE No. IX**  
**Domestic Markets for motors & generators**

	<u>Total</u> <u>1974</u>	<u>HP/kW</u> <u>1980</u>
A.C. and D.C. motors-HP	0.72 million	1.54 million
A.C. and D.C. generators-kW	0.37 million	0.84 million

On a 9% assumed annual rate of growth, the demand in 1985 was projected at about 2.37 million HP for motors and 1.29 million kW for generators.

12.4 There are, at present, seven important manufacturers of electric motors in Mexico of whom only three are making, in a limited way, motors above 200 HP, but have plans to enlarge their production. One of them has gone upto 1250 HP squirrel cage motors and has the capability to produce upto 3000 HP motors. None of them, however, is making even small sizes of synchronous or D.C. motors nor have they any definite plans as of now. Two companies are currently making A.C. generators upto 200 kW. in limited numbers and are planning to increase their sizes to 750 kW.

12.5 On the basis of weighted average prices per HP/kW (as per 1974 prices), the total market is estimated in sale value as follows:

	<u>Total value in million pesos</u>	
	<u>1974</u>	<u>1980</u>
A.C. and D.C motors	202	444
A.C. and D.C. generators	<u>125</u>	<u>274</u>
<b>T o t a l</b>	<u>327</u>	<u>718</u>

After deducting the value of anticipated local production (based on approximate estimates), the projected gap in production capacity as of 1980 will be as follows:

A.C. and D.C. motors	345 million pesos
A.C. and D.C. generators	<u>214</u> " "
<b>T o t a l</b>	559 million pesos

The above gap of 559 million pesos would provide a very adequate base for establishing new manufacturing capacity in the next 2 or 3 years.

12.6 The total gap for both motors and generators may be considered as an integrated whole, as the two products require similar technology and production facilities. About 85% of the gap (amounting to 475 million pesos) can be covered by local manufacture by creation of new facilities by the end of 1977, which would result in full production in about five years thereafter. It was estimated in the pre-investment study, that the capital investment for a single project of this scope would amount to about 220 million pesos plus a working capital upto 100 million pesos at the stage of full production. As it is considered unlikely that a single entrepreneurial enterprise would undertake an investment of the above magnitude in this sector, it was considered that a more practical alternative would be to support at least two projects, which would total upto the above overall investment and production capacity.

12.7 An important segment to be covered is D.C. motor/generator of all sizes. The programme for D.C. motor manufacture for the diesel locomotive, requires special administrative action. The D.C. motors for drilling rigs come under the same scope of manufacture and could also be taken up for production as early as possible. Even though the demand for large machines (4000-10,000 HP) in Mexico is not large in comparison with other countries, it would be advantageous to take them up for early manufacture even with a low level of integration to start with. Along with

a new enterprise, it would also be worthwhile to include repair and service facilities. The price structure of the existing manufacturers of small and medium motors is about 25% higher than U.S. levels and in the case of larger motors, this differential is much higher. During the next five to ten year period, when this industry will have to expand to cover a wider range and bigger sizes, it may require price support of about the same order in the initial stages when the economics of scale would not have been fully established. Although export efforts should start from early stages, positive results are likely to be realised only after 5 years and an export target of 15% increasing to 25% of the existing and additional motor and generator production appears practicable thereafter.

12.8 The very large size generators in the range of 75 MW to 750 MW used for power generation in thermal and nuclear power stations of CFE were excluded from the pre-investment study. It was considered that this should form a subject of separate study and if considered economically feasible for manufacture, one of the existing manufacturers of motor-generators could be encouraged to expand their operations to cover the large generators for power plants in due course.

#### Investment propositions

12.9 Following earlier exploratory negotiations, a reputed manufacturer from Japan submitted a proposal in late 1974 for the manufacture of A.C. induction motors in the range of 200-6000 HP (both squirrel cage and synchronous types) and A.C. generators upto 4500 kW. These proposals were further elaborated by mid 1975 in the light of a number of suggestions made by the group. The Japanese company have since entered into an arrangement with an important Mexican company, with a view to set up a joint project, which would also include NAFINSA equity participation. The total capital investment is envisaged at Ps. 13 million pesos and sales are projected at Ps. 28 million pesos by 1980. A revised, final proposal in the light of recent discussions between the 3 parties is expected shortly. In the meanwhile, an equally detailed proposal has been received from one of the major U.S. companies in this field for the manufacture, in Mexico, of asynchronous motors through 10,000 HP, synchronous motors of equivalent sizes, integral horsepower D.C. motors, wound rotor A.C. motors and special purpose of equivalent physical sizes. This proposal has also been the result of prolonged negotiations with the UNIDO-NAFIN Group extending over a period of over 1 year. The negotiations were initially taken up in Mexico, followed by detailed discussions regarding the project concept and the terms of collaboration in the company's headquarters in the USA, and thereafter again in Mexico. The revised proposal of this Company envisages a total capital investment of Ps 200 million pesos, while sales are expected to reach



216 million pesos by 1980. Details regarding the joint venture and technology license agreement have been discussed with NAFINSA recently. Besides the above two projects for setting up a major new manufacturing facility in Mexico, a third proposal is under consideration of another US electrical equipment manufacturer for participating in a joint venture for the manufacture of large size motors with a Mexican manufacturer of electrical items. The UNIDO-NAFIN Group has also been associated with discussions relating to this project.

12.10 It can be seen from the above that the prospects for investments in this subsector are very promising. By and large, both the major new project proposals have accepted the market estimates in the pre-investment study, though they have varying prejudices as to market penetration. There is undoubtedly need for at least one major new project and the approach should be to consider more preferably whichever proposal has the most comprehensive coverage in terms of meeting domestic requirements and developing export capability over a period of time, assuming of course that the other terms and conditions are broadly comparable in both cases. The first round of negotiations is likely to take place in the near future and it is hoped that an early decision can be taken. As far as the second proposal (i.e. expansion of an existing facility in Mexico), this also deserves every encouragement as there would undoubtedly be scope for such expansion. In fact, it would be reasonable to expect that at least two other domestic manufacturers of motors in the smaller ranges, who have access to U.S. technology, would also take up substantial expansion, so that both the production and technological gaps in this important subsector can be fully covered during the next 2-3 years.

#### Porcelain Insulators

13.1. With the growing demand for porcelain insulators from 65 kV. upwards, it was considered necessary to examine the possibilities of manufacture of such insulators in the higher ranges. Accordingly, a pre-investment study was taken up through an UNIDO expert during Nov. 1974-Feb. 75. At present, all electrical porcelain items above 31.5 kV. are imported. Two existing manufacturers, IUSA and PINCO, manufacture insulators for transmission lines upto 31.5 kV. The CFE is the principal purchaser of high-voltage insulators extending over 80% of domestic demand with the Compañía de Luz y Fuerza covering most of the balance. The pre-investment study indicated, if a new project was set up, this could be planned for an annual output of around 150 million pesos (1971 prices) during 1981-5 and rising to 200 million thereafter. A new plant, with the above capacity was estimated to require a capital investment of around 100 million pesos initially and rising to 125 million pesos in 5 years for machinery and factory services alone. The product mix suggested for such a plant was

a) suspension type disc insulators, b) post insulators, c) transformer bushings, d) porcelain enclosures for circuit-breakers and switchgear and for lightning arrestors, etc. The pre-investment study made an analysis of material requirements, approximate production costs and sales value, besides an assessment of raw material availability in the country.

13.2 The pre-investment study was followed by a detailed market analysis for each type of insulator by 2 NAFINSA engineers in the group, working under the supervision of Ing. Vélaz. This was a detailed and painstaking exercise and covered the market possibilities exhaustively and proved to be very useful in the course of negotiations.

#### Investment Propositions:

13.3. While the pre-investment study was still under preparation, exploratory negotiations were undertaken by the UNIDO/NAFIN Group and IUSA representatives with one of the major U.S. manufacturers of insulators. The plant headquarters were visited in this connection by the Group and, after some initial reluctance, the U.S. company has developed considerable interest in participating in a major expansion of IUSA facilities for insulator production, with a view to cover the principal items of domestic demand. Detailed negotiations have taken place in a series of meetings in Mexico between IUSA, the U.S. company and NAFINSA. The total additional capital investment envisaged is Ps 150 million pesos and it is projected that sales by 1980 would be of the order of Ps 100 million pesos.

13.4. With a relatively limited domestic market, there may not be room for more than one major project. Since the negotiations between IUSA and their prospective U.S. partners are already far advanced, this appears to be the most satisfactory approach.

#### Hydro Turbines:

14.1. With renewed emphasis on hydroelectric power generation during the last 3 years, it was considered necessary to review the possibilities of manufacturing such turbines in Mexico. Accordingly, an expert from UNIDO undertook the preparation of a pre-investment study in this regard from Oct. 75. The study has been completed in the last week of Jan. 1976. The principal features of the study are that (a) hydro-electric power

would increase from 3900 MW in 1975 to 13300 MW in 1985 and 23000 MW by the year 2000 which would more or less fully cover the hydro potential of the country (b) an estimated investment of over Ps 62000 million would be required over the next 25 years for such a generation programme, (c) the resource needs for turbine equipment alone, for such a programme would be of the order of Ps 7300 million & (d) the turbines required would be mostly of the Francis type, with capacities ranging between 60 to 300 MW.

14.2 The above projected requirements of hydro turbines is considered adequate for undertaking production of such turbines in Mexico. The demand, in terms of value, ranges from Ps 1880 million for 1978-80 to Ps 440 million pesos during 1980-85 (at 1974-5 prices). Though the demand would not be unduly high, a requirement of around Ps 500 million annually during 1980-85 would provide an adequate demand base for a medium-size production unit. The absence of such manufacturing facilities would necessitate the continuing import of turbines as at present.

14.3 There is considerable manufacturing capacity in Mexico for medium & heavy fabrication work. Plants such as the Industria del Hierro (Queretaro) & Metalver (Veracruz) have substantial fabrication capability. Despite this, however, almost the entire requirement of turbines in Mexico has been met by imports. Apart from lack of specialised know-how & experience in such manufacture, the machining facilities available with the major fabricators is fairly limited and would, for the most part, be inadequate for hydraulic turbine manufacture. Most of the major fabricators also have fairly full order-books at present & with the present growth trends in machinery & fabrication demand, there is likely to be considerable constraint in overall capacity. To the extent that surplus production capacity is available for periods of time, such capacity can be utilised through sub-contracting but it appears necessary that a new manufacturing facility for turbine production should be set up in Mexico, with adequate machining facilities & necessary technological support. Quality machining would particularly be required for heavy parts and components of hydraulic turbines such as runners, runner hubs, labyrinth rings, shaft protection housing, turbine discharge rings, head covers, turbine thrust bearings, gate mechanism etc.

14.4 In view of internal demand projections during 1980-85 it is considered that the proposed plant should have an initial fabricating & machining capacity of about 163,000 production hours/

annually during an initial phase of 3-4 years, going upto over 185,000 in terms of annual production hours during a second phase of 5 years, extending upto 1985, & upto 220,000 annual production hours during a long-term third phase. The total investment on such a new facility is estimated to be Ps 122 million for the first two phases & going upto Ps 170 million (1974-5 prices) in the final phase. Domestic integration could increase from 38% in the first phase to 56% by 1985 & over 75% in the third phase. Estimated sales are projected to rise from Ps 72 million by 1980 to Ps 114 million in the second phase upto 1985 & Ps 164 million in the third phase. Gross profit is estimated at over 10.8% on equity, assuming a debt-equity ratio of 1.1.

14.5 It is necessary to emphasise that the above production & investment estimates for a new manufacturing facility would be modified considerably if the manufacturing facilities proposed are undertaken by way of expansion. It is not possible to estimate the order of investment required for substantial expansion of one of the existing facilities. It must also be stressed that a major manufacturing facility of the type proposed which would have a fairly large range of heavy metal-cutting machine tools, would not be circumscribed in its production programme by the demand for hydro turbines & components alone. While these would constitute the base production load for such a production facility, the plant could obviously manufacture a wide range of mechanical equipment & components, particularly those requiring extensive machining operations. With the present gap in quality machining capacity in Mexico, such a plant would have considerable scope for taking up manufacturing activities other than hydro turbines & their major components.

#### Power Boilers:

15.1 While large industrial type boilers are being manufactured in Mexico by three major companies with fairly large production facilities, besides some other plants producing smaller industrial boilers & package boilers, the requirements of high pressure boilers for power stations still continue to be largely met through imports. The CFE, who are the only purchasers of such power boilers, have demand for individual unit sizes ranging earlier from 37 MW to 150 MW but now largely for 300 MW units. While such power boilers are presently ordered on foreign manufacturers, the latter use domestic production facilities to the extent convenient by way of subcontracting.

15.2 The variability of domestic production of power boilers depends on projected demand for such boilers over the next 15 - 20 years which, in turn, depends on the demand for fossil-fired electricity generating stations. In a techno-economic study conducted through an UNIDO specialist in 1974, it was estimated that thermal power generation through fossil-fired stations would be of the order of 1200 MW annually upto 1982-1980 & about 900 MW during 1990-2000. In view, however, of the greater emphasis now being given to hydro power generation, this estimate may have to be reduced to 900 MW annually upto 1990, which however still constitutes a sizeable internal demand.

15.3 While power boilers as such have not been produced in Mexico, two major manufacturers have delivered high-pressure boiler equipment to CFE. Both these companies are subsidiaries of reputed international boiler manufacturers, viz M/S Babcocks & Combustion Engineering. A third major manufacturer, who also has the equipment for production of high-pressure boiler parts is licensed by M/S Foster Wheeler. The techno-economic survey reviewed the existing production capacity in these three major plants in terms of man-hours & concluded that there would be a considerable gap in production capacity if power boilers upto 300 MW were to be undertaken for manufacture in Mexico. Such a capacity gap could either be covered by the establishment of a new facility or through substantial expansion of one of the existing plants.

15.4 It was estimated that a new manufacturing facility which could take up production of high-pressure boilers upto 300 MW & also nuclear parts & components over a period of time for the nuclear power generation programme, would be around Ps 163 million pesos (1973 prices) spread over a 4 - year period. Such a plant would require relatively assured orders for 2 x 300 MW power boilers annually over the period from 1978 to 1985, besides some industrial boilers & waste heat equipment and nuclear equipment, the production of which would commence from 1978-8. The above projected investment would not cover the manufacture of heavy boiler drums, as this may not be justified in view of the limited demand but would cover production of pressure parts, headers, economisers, superheaters & reheaters, membrane walls, waste-heat equipment & nuclear components over a phased schedule. It was estimated that, the new project would be quite viable with an internal rate of return of around 17% even with a price differential of 12% (against 15% normally provided for domestically produced equipment), provided the order-book was not substantially reduced. There would undoubtedly also be good export prospects as such a plant should be internationally competitive in the Latin American

markets at least, within a five year period.

15.5 The investment promotion activities in this sub-sector so far have largely concentrated on the possibility of expanding one of the existing plants to cover the high range of boilers for power stations. After considerable negotiations by the UNIDO-NAFIN Group a proposal has been received from one of the major boiler enterprises for substantial expansion. The proposal envisages additional capital investment of the order of Ps 47 million over the next 3 years. This proposal is under consideration in NAFINSA & it is hoped that a final decision can be taken shortly.

16.1 From the above analysis, it will be seen that, not only has the necessity for developing manufacturing capacity in respect of heavy electrical equipment been fully recognised by the UNIDO-NAFIN Group but very considerable progress has been made in promoting a number of projects for such manufacture. The additional capital investment envisaged together with the present stage of these projects is indicated in the table below.

TABLE No. X

In million pesos

Projected additional investment/ in electrical equipment manufacture

<u>Subsector</u>	<u>Projected additional investment</u>	<u>Stage of negotiations</u>
<b>a) Transformers</b>		
Project I (New)	150	Under negotiation
Project II (Expansion)	103	Under negotiation
<b>b) Circuit-breakers</b>		
Project (New)	60	In final negotiation
<b>c) Electric Motors &amp; Generators</b>		
Project I (New)	200	In final negotiation
Project II (Expansion)	30	Under negotiation
<b>d) Porcelain insulators -</b>		
Project (Expansion)	50	In final negotiation
<b>e) Boilers for power stations -</b>		
Project (Expansion)	47	Under negotiation
<b>f) Hydro Turbines -</b>		
Project (New)	170	To be considered
<b>Total</b>	<b>Ps. 810 million</b>	

16.2 While the above manufacturing programme would go a long way to meet Mexico's principal requirements of major electrical equipment, the growth pattern of electricity generation will necessitate constant review of equipment requirements, as also the possibilities of increased domestic manufacture. Some of the additional categories of electrical equipment which need to be considered in the near future are a) large turbines, b) large generators and c) nuclear components. In respect of high-pressure steam turbines, it is anticipated that the CFE's requirements may extend to 500 MW in a few years. It was earlier considered by the UNIDO Group that turbines for power stations would not be able to be manufactured economically in Mexico for some time. However, if CFE embarks on a significant programme for nuclear power generation, as is being contemplated, it may be possible to have an added demand for turbines, which may not be very significantly different in designs from conventional turbines, though of larger size. The possibilities of undertaking turbine manufacture could be revived in such a context. In respect of large generators also, the possibilities will need to be reconsidered if a major programme for nuclear power generation is undertaken. Such manufacture could also be combined with that of large turbines or could be processed as a subsequent expansion of a major plant for manufacturing motors and generators. As regards nuclear components, it may be pointed out that, while a nuclear reactor is undoubtedly highly sophisticated equipment, about 50-60% (by value) of its peripheral components and auxiliary equipment (such as pressure vessels, steam generators, piping, etc) could be undertaken for manufacture in Mexico, with an appropriate technology license and design and engineering support. It would be useful to undertake a pre-investment study of the possibilities in this regard, in view of the nuclear generation programme under consideration in Mexico.

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V. POSSIBILITIES FOR MANUFACTURING MECHANICAL EQUIPMENT (COMMON-USE ITEMS) IN MEXICO

17. While there has been considerable manufacturing growth of a wide range of small and medium-size mechanical equipment in Mexico in recent years, the production gap in relation to internal demand is also tending to increase, particularly in respect of more sophisticated and machinery products. The principal production gaps identified in respect of mechanical equipment of common-use are a) machine tools, b) steam turbines for industrial use, c) pumps compressors and centrifuges and d) diesel engines. In addition, a major bottleneck is developing in respect of infra-structure products, particularly heavy and medium castings, forgings and gears and speed changers. The possibilities of further manufacture in these fields are briefly examined hereinafter.

Machine Tools

18.1 The production of machine tools represent one of the most dynamic growth branches in the capital-goods sector in Mexico. Internal demand for a wide range of machine tools has grown rapidly and imports of metal-working machine tools alone were of the order of Ps.2,186 -- million during 1965-9 and Ps.3,796 million during 1970-4. It is estimated that imports during 1976-80 would rise to Ps.6,850 million during 1976-80 and to Ps.9,560 million during 1981-85 (both estimates on the basis of 1974 prices). The above import projections have taken into account not only normal expansion of some of the existing machine tool production units, but also the likely production of a major new machine-tool plant being set up in San Luis Potosí. Internal demand over the next decade is, therefore, likely to be over Ps.1,500 million annually and is likely to constitute a major production gap during this period. At the same time, it also provides a very significant opportunity for growth and expansion of manufacturing facilities in this field.

18.2 The UNIDO/NAFINSA Group prepared preliminary projections of internal demand initially in 1973. It was assessed at that time that total internal demand by 1980 would be Ps.1,400 million, of which -- Ps.942 million would be for metal-cutting machine tools such as lathes, milling machines, grinding machines, drilling machines, etc., while -- Ps.458 million would be for metal-forming machine tools. As against



this, it was projected that domestic production by 1980 would be only Ps.410 million, leaving a gap of Ps.990 million to be covered by imports. It was considered that the range of production of existing units were very limited. For the metal-cutting tool categories, there were 10 domestic enterprises, besides the new company, *Fábrica Nacional*, but both in terms of range and overall production, the existing facilities fell far short of demand. As for metal-forming machine tools, there is already considerable production of categories likely to have -- substantial demand in the next few years and consequently there is limited scope for additional domestic manufacture. About 15 companies are producing metal-forming tools such as hydraulic presses, bar cutters, guillotines, bending machines and the like. Domestic production is estimated to increase to Ps.300 million by 1980 against a total projected demand of around Ps.750 million (1974 prices). A considerable proportion of this figure would be represented by sophisticated, special type machines which may not be economically viable to produce in Mexico. Expansion programmes of the existing undertakings would, however, cover at least Ps.50 million of the shortfall in this machine tool subsector.

18.3 The machine-tool categories offering the most scope for local manufacture were parallel centre lathes, milling machines, grinding machines, drilling machines, etc. The above categories are, however, fairly broad and need to be analysed in greater detail. Simultaneously, with the work of the Group, two other separate studies relating to machine--tools were also conducted during this period. One of these studies constituted the basis of establishment of *Fábrica Nacional de Máquinas--Herramientas (FANAMHER)* which has since undertaken the production of certain categories of parallel lathes and milling machines, with technological collaboration of a Yugoslav machine-tool manufacturer. The second study broadly concluded that the other suitable categories for domestic manufacture would be turret lathes (*tornos revólver*), surface grinding machines (*rectificadores de superficies*) and single-spindle automatics (*tornos automáticos monohusillo*). Following this study, negotiations have been under way between another department of NAFINSA and a major machine-tool manufacturer in the UK over the last 3 years, but without any final decision so far.

18.4 A more detailed survey of internal demand and production possibilities for various machine tool categories was undertaken by the Group in 1974 through an UNIDO specialist. This was followed by an analysis of the import data by some of the NAFINSA counterpart staff and thereafter by a further review conducted in the latter part of 1975 by the UNIDO expert. This survey (1974-5) was fairly detailed and the field investigations covered the principal industrial users, besides the

existing manufacturing units, with the exception of the FANAMHER plant. The principal conclusions of the survey were as follows: in so far as the principal metal-cutting categories are concerned.

18.5 Centre lathes: It is considered that maximum annual demand would be for centre lathes of low price and relatively simple design principally from educational and technical institutions and from small jobbing and repair workshops. The demand for this category is anticipated at over 550 units annually constituting about 50% of total demand of such lathes. This demand has been partly covered by existing production (about 200-250 units annually) and partly by imports, which would gradually be replaced by FANAMHER production. Overall imports for centre lathes for the period 1969 to 1972 indicated a decline from 1430 to 790 units for these years respectively. However, 1025 lathes were imported in 1973, indicating a rising trend again. It is projected that overall demand for centre lathes by 1980 would be for 1,500 units. The analysis of imports indicate maximum imports from the USA (93 units in 1971 and 110 units in 1974) though total imports from the socialist countries in Europe was the highest in 1974 (121 units). However, imports from LAFTA countries also rose considerably and it is assessed that 55.7% of lathe imports in 1973 were from this region and principally from Brazil. As against the above demand projection, domestic production in the 4 principal manufacturing units could achieve a level of about 1600 units, particularly in view of the announced production programme of the FANAMHER plant. However, though total manufacturing capacity may be adequate in terms of units, it is considered likely that there will continue to be a gap in terms of user requirements and preferences, particularly for heavier machines in this category. Most of the existing manufacturing capacity relates to relatively light machines -below 10 HP- and even those models with ratings of 10 HP and more may not prove acceptable from the viewpoint of user preference. It is also necessary to take export possibilities into consideration as there is no reason why such lathes cannot be manufactured in Mexico at internationally competitive levels. Both in order to meet a growing internal demand for a high-quality and heavier centre lathe and in order to build up export capability, it is considered necessary that additional manufacture should be undertaken of a reputed and high-quality lathe in the category of 10-30 HP. and with dimension capacities of 300 mm and 600 mm diameter over bed and from 1 to 3 metres between centres. It is assessed that demand for such a quality lathe would increase to about 300 units annually by 1980, besides exports, once the facility can produce at internationally-competitive levels. Such a quality lathe would find application in tool-making, experimental and prototype production and special-purpose and relatively small-batch production in various industrial branches. In order to ensure high quality production for the home market needs and for

export requirements, it is considered necessary that such production should be undertaken in collaboration with a reputed international manufacturer, whose product has a high degree of international acceptability.

18.6 Turret lathes: In the 1974 survey, it had been estimated that the total demand for turret lathes would not exceed 250 units by 1980 & that this would justify the domestic production of 200 units by that year. This was in view of the imports of 192 & 144 machines in 1969 & 1972 respectively, a replacement rate of 3% on an overall population of 3500 units & after eliminating the projected requirements at the two extremes of usage. In the 1975 review, however, it was seen that 1974 imports of turret lathes amounted to 190 units, most of which could be covered within a limited range of production. Allowing for the development of export capability, it is now considered that domestic production of 240 turret lathes should be undertaken during 1976-8. The most popular range would have bar capacities of 26 to 52 mm (1 to 2 inches) while 2 or 3 other ranges could also be covered in different models.

18.7 Automatic lathes: The range covered by this category is very wide & extends to single & multi-spindle units for either bar or chucking work, besides hydraulic & electronic - control machines. Difficulty is caused in assessing the import figures because such imports are not sub-classified below the item 'automatic' lathes. An analysis of the 1972 estimates indicated that, out of 308 imported machines, 185 were of single-spindle type while the remaining were multi-spindle & other types. Both in view of the low demand & the high sophistication & investment needs, multi-spindle & special purpose automatic machines would have to be postponed to a later stage of machine tool production in Mexico. Even in respect of the single-spindle units, it would be extremely difficult to compete with the Traub machine, presently imported by Mexico from Brazil, & which covers about 15% of imports. The single-spindle automatic machine is a fairly intricate machine tool & would pose certain manufacturing problems even if internal demand proved adequate. The 1975 review covered a detailed analysis of 1974 imports of 340 automatic lathes. It appears that this import classification covers a large variety of sophisticated machines & that it would be extremely difficult to group this wide range into a single pattern of economic manufacture at this stage of development. In fact, despite the large number of machines imported under this classification, only about 100 of such machines would be of a type & category which could be manufactured economically in Mexico at present. It is accordingly considered that automatic machines, including single-spindle units, may be considered for the

next stage of machine tool development in Mexico, unless single-spindle machines are considered as part of a larger machine tool complex, as was considered in one of the investment propositions.

**18.8 Milling machines:** Though milling machines of certain models have been included in the production range of FANAMHER, these would not cover the overall internal demand for such machines. The number of units imported came to 467 in 1973 & 382 in 1974. Of these, practically 90% were of the knee-type &, of this type, about 50% were of the horizontal universal category. Allowing for 3% replacement of the current population of 5000 units & demand growth of 5%, the projected demand for milling machines would be well over 450 units by 1980. This would be partially covered by the FANAMHER production programme but would still leave room for a new project producing 200-225 high quality machines annually. Such a project is currently under final negotiations between NAFINSA & an Italian machine tool manufacturer. The new project would manufacture 190 machines in 3 models of milling machines, the Mo5u, the Mn2 & the M models. It is anticipated that the smallest model, the Mo5u would have to face competition from the FANAMHER model FB301 but this is not by itself, objectionable. It may, however, be necessary for this project to review its production programme & increase the production of MN<sub>2</sub> machines & reduce that of the M model, whose sales at the relatively higher prices necessary, may prove difficult, unless export capability is developed rapidly.

**18.9 Shaping machines:** Though the population of this type of machine tool has reduced considerably in the USA & Europe, shaping machines still constitute an important category, particularly in countries such as Mexico. Annual imports increased by 8% between 1969 & 1972, with an import of 245 units in 1972. It is likely that demand to this extent will continue for some time. The manufacture of shaping machines should, however, be undertaken in conjunction with one or more other machine tool categories.

**18.10 Grinding machines:** Imports of grinding machines totalled 262 units in 1972, with a growth rate of 6% for the period 1969-72. Allowing for replacements & projecting a fairly constant demand growth, it is assessed that annual demand by 1980 would be about 420 grinding units, of which the most popular category by far would be surface grinders. This category was included in the proposed project with the U.K. firm but this has failed to materialise so far.

18.11 Drilling machines: The 1973 import figures indicate a rapid growth in the demand for drilling machines, with 1307 units being imported, as against 899 in 1972. The increase was not only marked in respect of bench & light pillar machines, which could be covered by expansion of existing units but also in respect of the heavier type of radial & column drilling machines. This category is likely to generate enough demand to justify domestic manufacture of at least 500 units of various types.

18.12 The above brief resume of machine tool manufacturing possibilities clearly indicates that this sub-sector can develop very rapidly in the near future. Considerable interest was also displayed by a number of reputed, foreign machine tool manufacturers for participating in one or other project in Mexico. Apart from the prolonged negotiations between NAFINSA & the U.K. firm for the production of turret lathes, surface grinders & single spindle automatics, exploratory & firm offers were received by NAFINSA for (a) manufacture of lathes & milling machines from a reputed French manufacturer (b) production of turret lathes from a major German & a reputed U.S. manufacturer, (c) production of milling machines from an Italian machine tool company (d) licensing of radial & heavy drilling machines from an Italian manufacturer (e) manufacture of shaping machines from a German & a Swedish company (f) manufacture of sophisticated & high quality centre lathes from two U.S. manufacturers. Despite the extensive promotional activities undertaken by the UNIDO-NAFIN Group & the substantially positive response received from a number of reputed foreign manufacturers, investment decision has proved to be difficult. The only project which has been negotiated to a final stage is that of production of milling machines & involving a capital outlay of about Ps 90 million which project was first mooted during the Investment Promotion Conference in Vienna in Sept. 1973. In most of the other cases, it has not been possible to effectively proceed with negotiations because of the uncertainty regarding NAFINSA's negotiations with the U.K. company, covering three major categories of machine tools, & the comparative uncertainty of FANAMHER's future programme of production of new machine tool categories. While the earlier production programme of FANAMHER undoubtedly covers a major production gap & would have a significant impact on machine tool production in Mexico, it is essential that an early decision be taken as to whether new machine tool projects are to be promoted and encouraged or not. The prolonged negotiations with the U.K. company have also tended to slow down active promotional activities in this field beyond the stage of exploratory negotiations initiated by the UNIDO-NAFIN Group.

18.13 The question has been raised in discussions pertaining to the Capital Goods Programme, as to whether the development of machine tool manufacture should be promoted through only one complex or perhaps two, or whether a number of units should be set up, each specialising in one or other machine tool category. This issue has to be considered on a pragmatic basis. Technically, most or all of the 6 basic types of standard metal-cutting machine tools can be covered in one suitably designed complex. This may not, however, prove to be practicable or even desirable in the case of Mexico. Firstly, if capital participation by foreign technology suppliers is considered necessary, this by itself would result in independent & separate facilities, such as the new company being promoted by NAFINSA with Italian collaboration for the production of milling-machines. The expansion of such a facility to cover other machine tool categories is a matter in which the foreign partner would also have considerable say. Secondly, the growth of major complex necessarily involving the production of various machine categories of different degrees of sophistication & precision, may bring management & technological problems in its wake. The FANAMHER unit would, in a sense, be a major machine tool complex for relatively simple machines. Once this plant achieves its targetted production of 1100 centre lathes & milling machines, this itself would be a signalachievement & to complicate this major effort by adding additional sophisticated machine tool categories may not be desirable. Thirdly, for the appropriate development of skills, it would be more desirable for a complex to be allowed to grow gradually, instead of being weighed down from the start. Finally, considerations of resource mobilisation would also make it easier to promote 3 or 4 enterprises, specialising in different machine tools, rather than one major complex. Such enterprises can be promoted either independantly with NAFINSA as in the case of the milling machine project or by way of expansion of existing enterprises in Mexico. A list of such companies, which have developed expertise in such manufacture & who are interested in substantial expansion is enclosed at Schedule I to this chapter. In the circumstances mentioned above, it is considered that the more appropriate strategy for the growth of this key subsector should be to (i) encourage the growth of FANAMHER as rapidly as possible to achieve its targetted production capacity of 1100 centre lathes & milling machines (ii) establish a new facility for the production of milling machines, as is already under final negotiation (iii) promote a new project for which necessary collaboration is available for the manufacture of high-quality centre lathes, which can meet more sophisticated internal requirements & can penetrate export markets without difficulty

(iv) promote a new project for the manufacture of 240 turret lathes annually in collaboration with a U.S. or other foreign manufacturer who has expressed interest in such manufacture either in conjunction with (iii) above or independantly, (v) promote a new project or substantially expand an existing enterprise to undertake, with foreign licensing, the production of 420 grinding machines annually, particularly surface grinders (vi) promote a new project or substantially expand an existing enterprise to take up production of about 240 shapng machines annually & (vii) substantially expand an existing enterprise to cover the manufacture of drilling machines, including radial & column type. It is estimated that, apart from the investment in the FANAMIER facility, the remaining branches of the machine tool subsector discussed above would necessitate a total investment of between Ps 250 million to Ps 300 million over the period 1976-1978, the actual volume of investment depending on the extent to which the various proposed can be undertaken jointly or have to be pursued as independant projects.

#### Steam Turbines (for industrial use)

19.1 Despite the considerable demand for steam turbines for industrial use, particularly in the range upto 6000hp, there is no manufacture of steam turbines in Mexico at present. Excluding the requirements of turbines for power generation, imports of steam turbines for industrial use has grown steadily grown to an average of around Ps 21 million annually over the last 3 years. The principal requirements are those of Petroleos Mexicanos, sugar & paper industries and C.F.E. though such turbines are also utilised in other industrial sectors.

19.2 The manufacture of steam turbines was identified by the UNIDO-NAFIN Group as having considerable potential in Mexico. In 1973, the Group was approached with a letter of intent jointly from a U.K. & a German (FRG) company. This was followed by discussions during the Investment Promotion Conference in Vienna in Sept. 1973 & the UK company agreed to undertake a pre-investment study in collaboration with the UNIDO-NAFIN Group. This was submitted to NAFINSA in Nov. 1974. The salient features of the study were that (i) internal demand in Mexico was projected to increase from about Ps 19.7 million in 1972 to about Ps 28 million by 1978 (ii) the overall Latin American market for steam turbines was likely to be of the order of Ps 120 million annually during 1978-80 for turbines below 1000 hp & (iii) the internal market

in Mexico was adequate to initiate production of both single-stage & multi-stage machines. The UK Company proposed an initial investment of Ps 3.7 million on machine tools using rented space. The single stage machines would be of German design, while the multi-stage units would be of British design. Negotiations relating to this project, however, got stalled in Dec. 74 owing to lack of agreement between the UK & German parties as to their respective holdings in the proposed Mexican project and the proposal has since been withdrawn.

19.3 The UNIDO-NAFIN Group has, in the meanwhile, been in touch with a number of steam turbine manufacturers in Europe & USA. Considerable interest was displayed by two of these manufacturers with whom the Group got in touch & with whom detailed preliminary negotiations were conducted. One of these manufacturers submitted a feasibility study for the production of 100 turbines annually mostly in the range upto 1000 hp. The initial capital investment was estimated at Ps 16 million, with 60% integration being achieved in the 3rd year. Unfortunately, the reaction of PEMEX to this proposal was somewhat negative & the proposal was not pursued. In the second case, however, the proposal has proceeded considerably. The Company is planning an initial investment of nearly Ps 20 million. Since this U.S. company is part of a major multi-national group, they would be going ahead with their own resources & within the corporate framework of an existing Mexican company. It is expected that initial investment would start by the early part of 1976. The establishment of a second project for steam turbines can also be considered, either as a new facility or by way of expansion. The investment requirements would be around Ps 80 million for such an unit.

#### Pumps, Compressors & Centrifuges:

20.1 There has been considerable growth of manufacture of pumps & reciprocating & air compressors in Mexico over the last decade. A wide range of pumps is being manufactured by a number of manufacturers among which some of the most important are Byron Jackson, Worthington & Fairbanks Morse subsidiaries & affiliates in Mexico. A number of small manufacturers have also developed in recent years, mainly catering to the increasing demand for agricultural & small irrigation pumps. The growth of the pump industry has been such that domestic capacity is considered to be adequate for various types of pumps, including horizontal ejector pumps, horizontal centrifugal pumps, horizontal centrifugal 2-way pumps, self-starting centrifugal pumps of low hp., horizontal



turbine pumps & vertical turbine pumps upto 350 hp. The production of mud pumps has also been undertaken since 1973-4, which would greatly reduce the import of pumps by PEMEX, though domestic production capacity would need to be further increased, if PEMEX's rapidly increasing needs of mud pumps are to be fully met. The types of pumps still not produced are some types of non-corrosive pumps for the chemical industry, large-size pumps for water supply & for sewage disposal, metering pumps & pumps for testing of certain equipment at high pressures. A large number of high-precision rotary pumps (over 110,000 per annum) continues to be imported for the artificial fibre industry. The projected imports of special purpose & sophisticated pumps is Ps 2580 million during 1976-80 & Ps 4000 million during 1981-85, with projected imports of about Ps 650 million in 1980.

20.2 It must be stressed that, though projected imports are likely to continue to be high, some of the principal pump manufacturers in the country have also completed fairly extensive expansion programmes. One of the companies has taken up production of centrifugal pumps upto 3000 hp & process pumps in nodular design in different material, besides mixed flow pumps upto 50,000 m<sup>3</sup>/h. Another manufacturer has undertaken production of large size pumps for water supply etc. upto 10,000 hp. The special purpose pump requirements of the pulp & paper industry has been undertaken by another manufacturer. Yet another company is contemplating the establishment of new facilities for the production of centrifugal process pumps of different types including multi-stage, split casing & barrel types. Submersible pumps are also proposed to be domestically produced. As mentioned earlier, the production of mud pumps has already been undertaken by one manufacturer, though capacity in this regard would have to be increased considerably. By & large, pump manufacture has developed very considerably in recent years & continues to grow rapidly.

20.3 Despite the rapid growth of the pump industry to cover fairly sophisticated & special purpose requirements, there continues to be possibility for taking up certain new lines. These are (i) re-injection pumps of 2000 to 4000 hp for which there will be a demand of 10-15 units annually by PEMEX, (ii) boiler feed pumps for power boilers to be supplied to CFE, the requirements of which may extent to 15 units of 3000 hp during 1976-8 & even higher number of 6000 hp units during 1978-80 & thereafter & (iii) large pumps for sewage disposal & urban requirements, the demand for which is likely to grow rapidly in the next 5 years.

20.4 Since a number of affiliates of reputed manufacturers in the USA & Europe are already operating in the country, it was not considered necessary to specifically promote new ventures for pump manufacture. Most of the future requirements can be covered by suitable expansion of the facilities of one or other of the existing manufacturers. What would be more necessary would be a better programming of purchase orders on the part of the principal user agencies such as PEMEX & Recursos Hidráulicos Department so that imports are avoided or are reduced substantially.

Compressors:

21.1 The domestic manufacturing capacity for air compressors is considered to be quite adequate as a number of manufacturers are manufacturing this item. Capacity, in fact, has tended to be higher than internal demand & export outlets are being explored by some of the enterprises. Despite such capacity, considerable imports of air compressors have also taken place, mostly from the USA. It is presumed that this would not take place in future. In respect of reciprocating compressors, facilities already exist in Mexico & one of the companies is manufacturing such compressors upto 5000 hp & has received orders from PEMEX in this regard. It is likely, however, that demand for reciprocating compressors may fall, particularly in respect of PEMEX orders, with greater emphasis on centrifugal compressors & with possibility of manufacture of screw compressors in Mexico.

21.2 There are no facilities for the manufacture of turbo-compressors at present in Mexico. Imports have steadily increased & are continuing to increase at present with higher unit sizes. Projected imports of turbo compressors, moto compressors & other types of compressors are of the order of Ps 3200 million during 1976-80 & Ps 5032 million during 1981-5. The annual demand in 1980 is likely to be about Ps 650-700 million for various types & ranges of compressors while demand for centrifugal compressors is expected to extend from Ps 250 million annually. These figures indicate that there would be adequate potential for domestic production of centrifugal or turbo-compressors in the future.

21.3 Apart from centrifugal compressors, the techno-economic study of this branch indicated that there would be good potential for the manufacture of screw compressors in Mexico. A proposal for such manufacture had been received earlier by the UNIDO-NAFIN Group, from a Mexican affiliate of a well-known U.S. producer

who are considering an additional investment of about Ps 50 million for covering screw compressors & certain other products. The UNIDO specialist considered the manufacture of screw compressors as a desirable technological development & the Group had recommended the proposal of the Mexican affiliate to Nacional Financiera for participation by the latter in the expansion of the company. This proposal is under consideration in Nacional Financiera.

21.4 As for centrifugal compressors, a number of major compressor manufacturers in the USA were contacted & requested to participate technologically & financially in a project for such manufacture in Mexico. Very positive response was received from one of the foremost manufacturers of compressors. A market study team of this company visited Mexico in Jan. 1975 &, after various field visits & discussions, confirmed their acceptance of the internal market figure for centrifugal compressors being around Ps 250 million annually. It was agreed that the most suitable arrangement for taking up such manufacture would be to expand the facilities of an existing Mexican company producing reciprocating compressors & other products at present. Negotiations between the two companies & the UNIDO-NAFIN Group continued over nearly 10 months & it was only in Nov. 1975 that it was concluded that no satisfactory arrangement could be arrived at between the US & the Mexican companies. The US company has since been exploring the possibilities of collaborating with some other enterprises in Mexico for manufacture of their compressors & the UNIDO-NAFIN Group are awaiting further developments in this regard. The US company have intimated that, for the manufacture of their compressors (upto a certain range) an investment of around Ps 32.5 million would be required for a grass-roots facility. With such investment, domestic integration on the compressor portion (excluding the turbine or rotor) would be 30% in the first year & over 65% during the third year. It is considered that 'his proposal for manufacture of centrifugal compressors is very desirable & needs to be encouraged. The US company have agreed in principle to hold a minority interest in the Mexican company to be established for setting up this joint venture & this commitment should ofcourse apply, irrespective of whether a grass-roots facility is established or the project is undertaken as a substantial expansion of an existing enterprise, which may already have considerable foreign ownership. Subject to this, there should not be any undue difficulty in arriving at a suitable solution, as the negotiations are already far advanced.

21.5 The two projects for the manufacture of screw compressors & centrifugal compressors respectively would involve additional capital investment of over Ps 82 million & would contribute significantly to domestic growth of this sub-sector .

Centrifuges:

22.1 With the rapid growth of the sugar & chemical industries in Mexico in particular & with industrial expansion in general, the demand for centrifuges has increased considerably in recent years. During the next decade, it is projected that imports of centrifuges would be of the order of Ps 1010 million during 1978-80 & Ps 1700 million during 1981-5.

22.2 A project for the manufacture of sugar centrifuges had been sponsored by the UNIDO-NAFIN Group in 1973 with an UK manufacturer. Subsequently, the project grew in a relatively small way without the financial participation of Nacional Financiera & with only the participation of a Mexican company. In 1975, a major order for 150 centrifuges of a value of about Ps 130 million was contemplated by the public sector sugar industry. It was possible for the earlier project to be considerably revitalised & enlarged as a result of this major order. The total capital investment of the manufacturing company has been increased to Ps 13.8 million, with substantial financial participation by Nacional Financiera also. This was a good example of linking a major bulk order with the substantial expansion of a domestic machine building enterprise, which would otherwise have probably developed at a very slow pace.

Diesel Engines:

23.1 Though diesel engines are produced by 7 manufacturers at present, a considerable gap is developing in respect of the higher ranges. The present manufacturing capacity extends from 7 hp to around 340 hp, the latter largely for industrial use. The total number of diesel engines manufactured in Mexico rose from 15044 units in 1968 to 29,895 units in 1974, while, in terms of value, production rose from Ps 709 million in 1968 to Ps 1814 million in 1974. Three of the manufacturers are producing such engines principally for their parent & associated companies. Of the remaining four, the production capacity is of 10,000 & 8000 units for the two

large producers & 1500 & 500 units for the two smaller production units.

23.2 The production gap in this sub-sector is not only confined to diesel engines of higher ratings but also of certain major parts & components such as crankshafts, connecting rods, camshafts, rocker arms & supports, fuel pumps & fuel injection equipment. Present imports extend to most of the latter items. In a survey conducted in 1974 through an UNIDO specialist working as a member of the Group, it was noted that considerable imports were also taking place of engines upto 500 hp. In fact, for the period 1968-72, over 86% of imports were in respect of diesel engines upto 500 hp, and only 8.5% for ratings of 501 to 1000 hp with only 5% above 1000 hp. The pattern of demand is gradually extending to a greater demand volume for engines in the higher ranges. By 1980, the principal demand for diesel engines will be (a) from the automotive industry, whose requirements would be about 33000 units in the smaller categories, (b) from agriculture, where the demand would be about 7500 units of various categories (c) from the industrial sector, whose demand would be over 5500 units, with considerable demand in the higher ratings for electricity supply in the outlying areas & for the petroleum & allied industries (d) in respect of marine use, particularly fishing boats whose demand would be about 240 units & (e) for diesel locomotives, where the demand may be around 40 large units. Projected imports for the periods 1976-80 & 1981-85 indicate that, at 1974 prices, imports would be of the order of Ps 4220 million and Ps 7000 million for these two periods.

23.3 The production gap in this sub-sector can be effectively covered by (a) expansion of one or more of the existing manufacturing units & (b) establishment of a new facility, concentrating principally on the manufacture of diesel engines in the range of 400 hp to 2000 hp. Exploratory negotiations with the principal domestic manufacturers has indicated that, while there is a general desire to expand existing facilities so as to cover higher ranges, there are no specific proposals immediately under consideration of these companies. On the other hand, a proposal is under consideration for the establishment of a new facility for the manufacture of diesel engines of a well-known U.S. make. The negotiations conducted by the UNIDO-NAFIN Group, with the U.S. group interested in such production, are fairly advanced & it is expected that final investment decisions will be taken very shortly. It is intended that a new facility would be set up at a suitable location in Mexico (a site in Guadalajara is presently under consideration). The capital investment required for the manufacture of diesel engines of 400-2000 hp

starting with 85 units in the first year & going upto 250 units in the 4th year in accordance with a phased integration programme, has been assessed at Ps 71 million, besides proportionate investment on land & buildings, which will also be utilised for the production of centrifugal compressors & certain special purpose pumps of high capacity. The new facility would be set up through a new company, in which the Mexican side (which would probably be Nacional Financiera) would have a majority holding of 51% with 49% held by the U.S. group.

23.4 With the implementation of the proposed new project, a substantial portion of the gap in the higher ranges of diesel engines would be covered. This would, however, still leave enough room for expansion of existing production units to cover part of the growing internal demand & to develop export capability. It is also necessary that major components & sub-assemblies should be manufactured in Mexico as early as possible. A proposal for the manufacture of crankshafts, which had been negotiated earlier on a preliminary basis with the UNIDO-NAFIN Group, is now separately in an advanced stage of negotiations & it is expected that similar developments will take place in respect of other major components & sub-assemblies.

Foundry facilities:

24.1 With a rapid projected expansion of the capital-goods sector in Mexico, a major infra-structure industry which needs to be considered is the production of castings. Though there are about 430 foundries in Mexico, including a few well-equipped units, a major production gap is likely to develop in respect of availability of heavy & medium castings of 3 to 15 tons in weight. A techno-economic survey of the foundry industry in Mexico conducted through an UNIDO specialist working as a member of the Group, highlighted the fact that there would be a serious shortfall in capacity if major machine-building manufacture was undertaken. As far as steel castings were concerned, it was considered that existing domestic capacity would be adequate, though some of the steel foundries would require substantial expansion. It is suggested, in this connection, that some of the steel foundries should introduce 'triplexing' operations, involving a cupola, a side blown convertor & an electric holding furnace to store the hot steel melt till the stage of pouring. In respect of gray-iron castings, it is pointed out that only 14 foundries have an annual capacity of more than 5000t. These units, however, cover 48% of total capacity. Most of these units have expansion plans under consideration but these are primarily to increase their present lines of production e.g. automobile castings, pipe connections, household hardware, castings for small motors, pumps, etc. as

*in most of these cases, the order-book is very satisfactory at present. By & large, however, with notable exception in the case of 3-4 foundries, quality of castings has tended to be inadequate even in the case of foundries which can handle weights upto 3 tons.*

24.2 In respect of demand projections for castings from 3 to 15 tons, this would inevitably depend on the actual growth of machine building enterprises. An estimate of such projected requirements has been made on the basis of the various projects under consideration as part of the Capital-Goods Development Programme. It is estimated that the requirements of medium & heavy castings (3-15 tons) for such a programme would be about 19000 T annually by 1980, while the demand for castings below 3 tons per piece for such a programme would be around 14000 T annually by that year. It is expected that the production gap in quality castings would be at least of this order. It is consequently considered that a major new foundry should be set up in Mexico with an annual capacity of 24,000 T. of castings, principally to meet quality & weight demands of the additional machine-building enterprises likely to be set up in the near future. The techno-economic study also made an assessment of the likely capital investment that such a new foundry might entail. It is estimated that such a new facility would require an investment of Ps 168 million, of which the cost of machinery & equipment is estimated to be around Ps 121 million (at 1974 prices). Such an investment could be completed in a 2-year period & needs to be established by 1978-9 in order to meet the requirements of the machine-building sector in the very near future. Growth of production is anticipated to be 15,000 T of high quality castings by the 3rd year & 24,000 by the 5th year from commencement of production while sales are projected to grow to Ps 375 million by the 5th year. It should be possible for such a facility to also produce pig-iron to supplement the sales income of the foundry. With the continuing shortfall in raw material for the overall foundry requirements of the country, there should be a ready market for between 50,000 to 75,000 T of pig iron, during the early production years of the foundry, when production of castings is gradually being developed.

24.3 The question of establishing foundry facilities to meet the future gap is under consideration in NAFINSA & in at least one of the major steel companies which has been diversifying its production lines. An interesting alternative project has been drawn

up by one of the NAFINSA engineers working in the UNIDO-NAFIN Group, working in collaboration with the planning group of the steel company. This contemplates the setting up of a foundry for ingot moulds, with a manufacturing capacity of 15,000 T/annually of medium & heavy castings. The fixed capital investment for the foundry unit would be reduced to Ps 41 million, while sales are projected at Ps 306 million by the 5th year. Another proposal under consideration is for substantial expansion of an existing foundry to cover the production of steel rolls, bed-plates & miscellaneous castings, covering part of the weights discussed above.

24.4 It is considered extremely important that an early decision is taken by NAFINSA for the creation of additional foundry facilities for meeting the increasing demand for quality castings of higher unit weight. The absence of such a new facility is likely to constitute a major bottleneck for the growth of the capital-goods industry in Mexico. While one of the alternatives being contemplated would partially meet the problem, the real solution lies in a major new foundry unit being set up. A lead needs to be taken by NAFINSA in this regard.

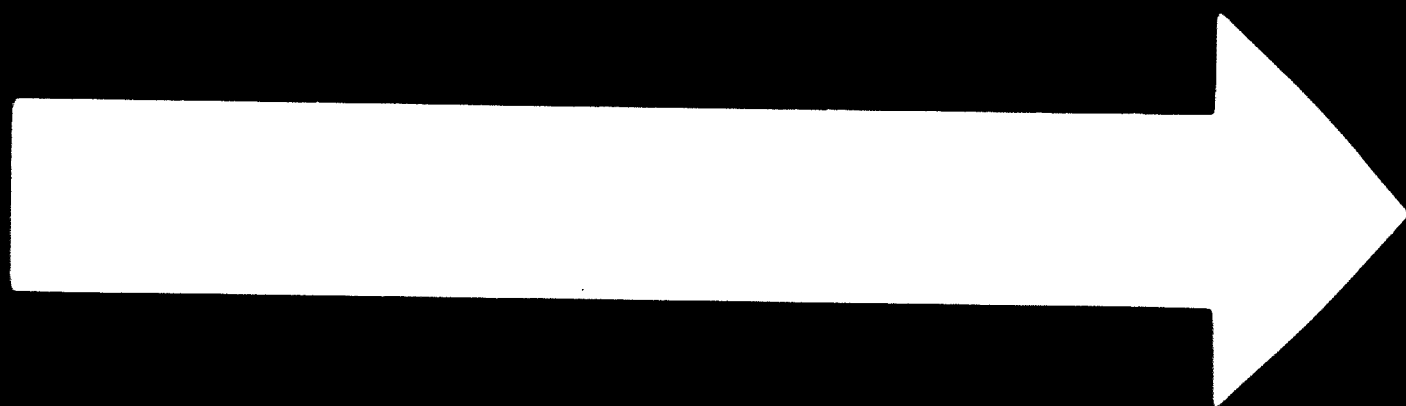
24.5 An important feature of a major new foundry designed to cover unit weights upto 15 tons would be the likely export capability of such an unit, particularly to the USA. While some foundries are already exporting to the USA, such exports are confined to light weight items. The demand for quality castings in the USA is very high & it is generally accepted that a number of major machinery manufacturers are having problems in obtaining castings of requisite quality. The establishment of a major new foundry in Mexico, designed specifically to produce quality castings & going upto 15 tons in unit weight would undoubtedly provide an excellent source for export of castings to the USA.

#### Gears & speed changers:

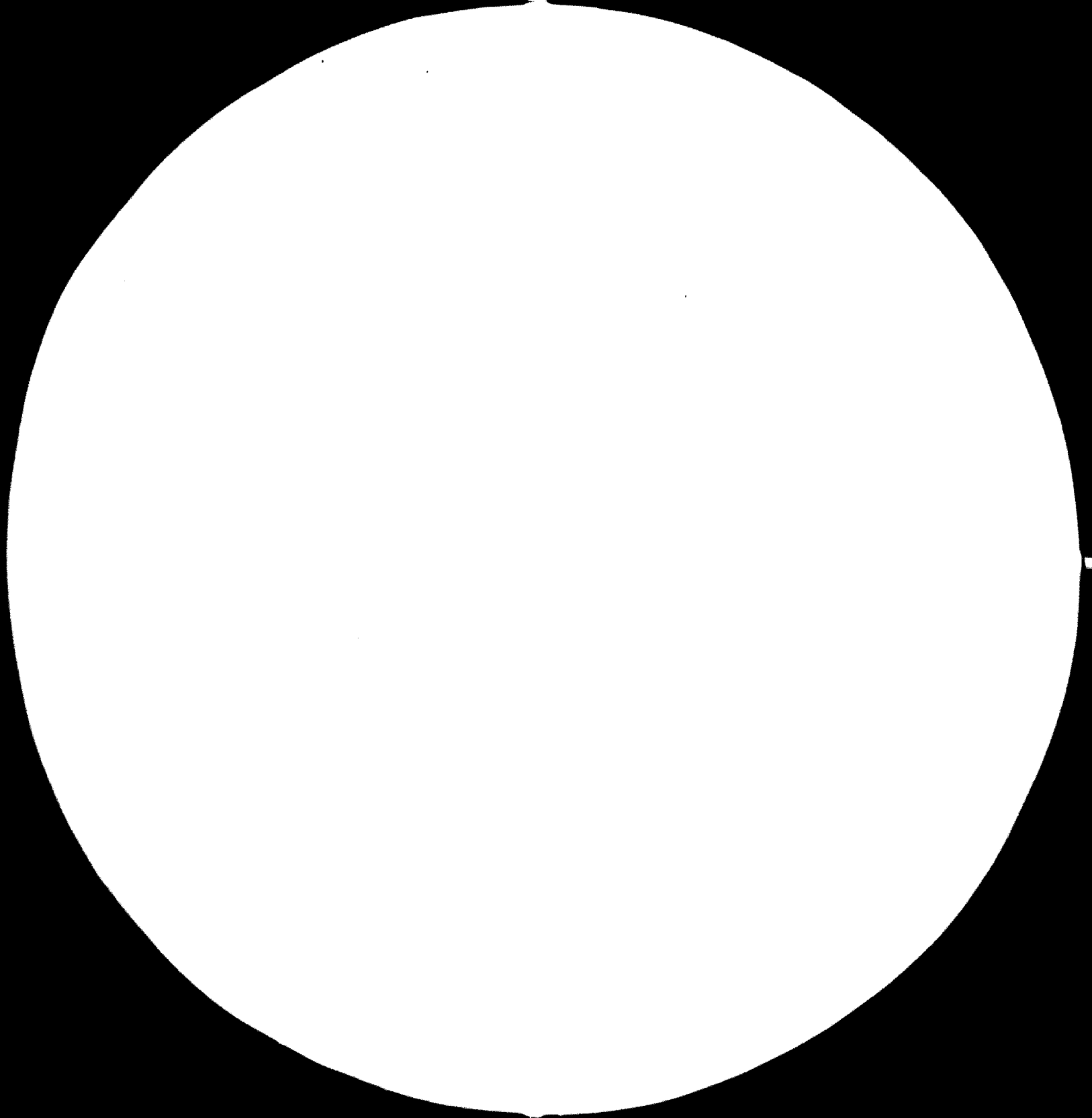
25.1 An infra-structure subsector which would be of considerable significance for the effective growth of the capital-goods branch would be the production of gears & speed changers. With increased machinery manufacture, the demand for these two items would rise rapidly & may constitute a bottleneck. There are 9 companies manufacturing such items in Mexico at present but four of these are relatively small units. One major unit produces about 40% of domestic capacity &, in conjunction with four other units,



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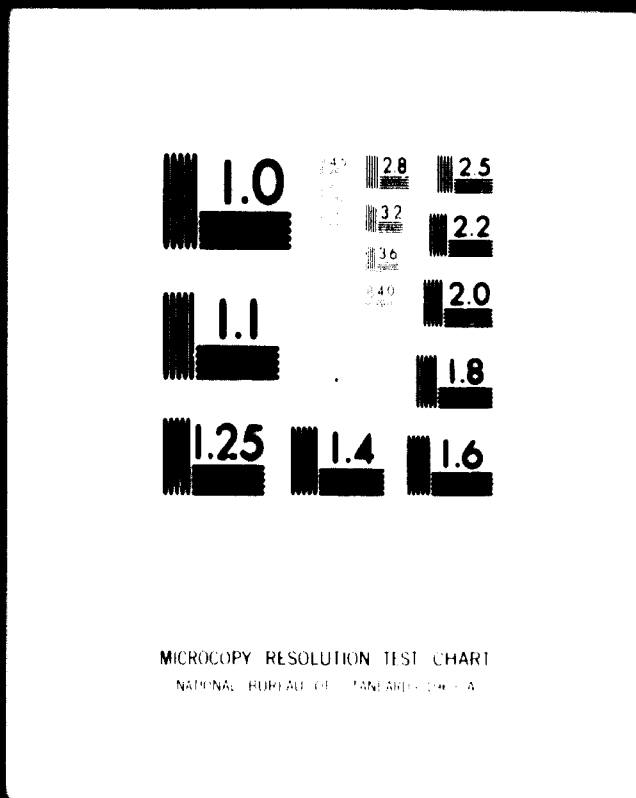
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produces about 85% of total production. Internal production rose from Ps 44.3 million in 1968 to Ps 78 million in 1972 & is estimated to be about Ps 95 million in 1974. This figure, however, includes imported material which not locally produced because of lack of heat treatment facilities. The volume of imports of gears & speed changers was of the order of Ps 40 million annually during 1968-72. With the growth of the machine-building sector, it is expected that the production gap will rise to around Ps 85-90 million by 1980 & is likely to increase at a growth rate of 11% during the period 1981-5.

25.2 In a techno-economic study of this sector conducted in 1974-5 through an UNIDO specialist, it was concluded that the production gap for gears & speed changers would justify the establishment of a new plant which could (i) undertake manufacture of speed changers upto 25 T & (ii) take up machining of gears upto 1500 mm dia & grinding of gears upto 800 mm dia. Such a unit would need to be equipped with special machine tools, such as gear hobbers & gear cutting machines. The total capital investment required for such a project would be Ps 43 million spread over a 3 year period. Such a facility could develop an output of Ps 75 million per annum in a 3-4 year period & would be a fully viable proposition.

Forgings, standard parts & measuring tools:

26. Besides castings & gears & speed changers, it had been considered, in Phase IB of the Capital Goods Project, that bottlenecks are also likely to develop in respect of the availability of forgings of medium weight, standard parts & measuring instruments. No study in respect of forgings was undertaken by the UNIDO-NAFIN Group, as this sector was being separately studied in another branch of NAFINSA. As a result of these studies, a new company FORJAMEX has already been constituted & is taking up the production of forgings, though of relatively low weights. It may be desirable for the new company or for NAFINSA to take up a techno-economic study of the requirements of heavy & medium-weight forgings. As for standard parts, such as jigs, dies, fixtures, patterns & the like, no detailed study was conducted & this may also be considered at a later stage of capital-goods development in the country. In respect of measuring instruments, it is considered that the growth of demand would be able to be met by expansion of one of the two companies manufacturing these products. It is understood that such expansion is under serious consideration by these companies.

General:

27.1 Mechanical equipment for common-use in different sectors necessarily covers a wide range of machinery manufacture. The coverage of the UNIDO-NAFIN studies is not exhaustive but does extend to the principal subsectors which need special emphasis & priority. An important item viz heat-exchangers has been separately dealt with as part of chemical & petrochemical equipment in the next chapter.

27.2 The various proposals handled by the UNIDO-NAFIN Group in respect of new capital investment for mechanical equipment in common use is summarised below in Table

<u>Subsector</u>	<u>Investment required</u>	<u>in million pesos</u> <u>Stage of negotiations</u>
<b>1. Machine Tool</b>		
(a) Project I- milling machines	90	Decision taken
(b) Other projects for (i) centre lathes (ii) turret lathes (iii) grinding machines (iv) drilling machines & (v) shaping machines, either in one or two complexes or as separate units.	300	Negotiations to be undertaken Various offers received earlier.
<b>2. Steam turbines</b>		
(a) Project I- (Expansion)	30	Being undertaken as expansion of major existing facility
(b) Project II- (New project or expansion)	80	For consideration later by NAFINSA

<u>Subsector</u>	<u>Investment required</u>	<u>Stage of negotiations</u>
<b>3. <u>Pumps, compressors &amp; centrifuges.</u></b>	<b>32.5</b>	<b>Under negotiations</b>
(a) Project I-centrifugal compressors (new project)		
(b) Project II- screw compressors (expansion)	<b>50</b>	<b>Under negotiations</b>
(c) Project III-centrifuges (expansion)	<b>13.2</b>	<b>Decision taken</b>
<b>4. <u>Diesel engines</u></b>		
(a) Project I-(New project to be undertaken jointly with 3(a))	<b>71</b>	<b>Under negotiation</b>
<b>5. <u>Foundry</u> -(new project)</b>	<b>108</b>	<b>Under consideration</b>
<b>6. <u>Gears &amp; speed changers</u> (new project)</b>	<b>43</b>	<b>To be considered</b>
	<hr/>	
<b>T O T A L</b>	<b>Ps</b>	<b>867.7 million or 868 million</b>

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**CHAPTER V**  
**SCHEDULE I**

**Machine - Tool manufacturing companies in Mexico having facilities or interest & experience appropriate for the manufacture of machine - tools\***

<b><u>Company</u></b>	<b><u>Location</u></b>
1) Dreis & Krump de Mexico, S.A.	Monterrey
2) Empac - o - matic, S.A.	México, D. F.
3) Endor, S.A.	México, D. F.
4) Fabricación de Máquinas, S.A. (FAMA)	Monterrey
5) Industria Automotriz de Cuernavaca, S.A.	Cuernavaca
6) Industria Automotriz, S.A. (IASA)	Monterrey
7) Industrial del Hierro, S.A.	Queretaro
8) Maquinaria, Herramientas y Servicios, S.A. (MAHERSSA)	Queretaro
9) Mecamex, S.A.	Tlalnepantla
10) Mecánica Falk, S.A. de C.V.	México, D. F.
11) METEORO (Fabricaciones Metálicas, S.A.)	Toluca
12) Motores y Refacciones, S.A. (MORESA)	México, D. F.
13) Sweco mex, S.A.	Guadalajara
14) Tecnomec, S.A.	México, D. F.
15) U.S.M. Mexicana, S.A. de C.V.	México, D. F.
16) Talleres Castellanos, S.A.	Monterrey
17) Construcciones Mecánicas, S.A.	
18) Industria Mecánicas Eléctricas, S.A. (IMESA)	Ecatepec

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\* Reproduced from report of R. Langley, UNIDO machine tool expert & member of the UNIDO Group.

## VI. POSSIBILITIES FOR MANUFACTURING MECHANICAL EQUIPMENT IN MEXICO FOR SPECIFIC INDUSTRIES

**28.1** The principal industrial sectors other than electricity generation & electrical equipment manufacture, which individually constitute sizeable demands for machinery & equipment specifically designed & manufactured for these branches are (a) textiles, (b) iron & steel (c) non-ferrous metals, (d) chemicals including petroleum refining, petrochemicals & fertilisers (e) cement (f) sugar (g) food-processing (h) construction & mining (i) pulp & paper (j) printing & (k) mechanical equipment manufacture. In some of these sectors, particularly the chemical & petrochemical industry, the equipment may be quite distinct but have been grouped under more generic classifications in the SITC & BTN lists. Apart from the specific machinery required by these sectors, all these branches require a wide range of common-use equipment which have been briefly analysed in the previous chapter.

**28.2** The techno-economic studies conducted by the UNIDO-NAFIN Group have not extended to all these sectors. Apart from electricity generation & electrical equipment manufacture, which were examined in detail, the survey of manufacturing possibilities was concentrated in respect of only three of these sectors viz textile equipment, machinery for iron & steel production & equipment for the chemical & allied industries. The studies in respect of textile equipment & machinery and the chemical & allied industries were completed in 1975 & early 1976 respectively while that on iron & steel equipment will be completed by May 1976. Similar studies were to be taken up in respect of (a) food processing equipment & (b) heavy mechanical equipment, which would have covered the detailed requirements of equipment for the cement, pulp & paper, mining & mechanical equipment manufacturing industries but these have had to be postponed for the present. By & large, however a general idea regarding the requirements of machinery & equipment for these sectors is available from the import trends & projections.

### Textile equipment

**29.1** With projected imports of over Ps 9500 million in 1976-80 & over Ps 13500 in 1981-5, the production of textile equipment in Mexico presents very dynamic possibilities. A techno-economic pre-investment survey was conducted through a consultant



company, appointed by UNIDO (the ICME-CONDOR Consultants), working in close consultation with the UNIDO-NAFIN Group. This study was completed in March 1975.

29.2 The textile industry is one of the largest indigenous industrial sectors in Mexico. The total capital invested in textile production is estimated at about Ps 28,000 million. The total spindleage amounts to over 2.3 million units, of which about 145,000 are owned by textile co-operatives while about 4.8% is state-owned. Total loomage is estimated to be around 46,000. The industry is highly competitive & a number of units (76) have closed down since 1964. The growth of artificial fibres has been particularly marked in recent years, with total mill consumption of artificial fibres & filaments rising from 38000 t in 1965 to over 133,000 t in 1973. It is projected that, by 1980, this would rise to 412,000 t. Consumption of artificial fibres has risen from 7.9% in 1969 to 40.9% of total domestic fibre consumption & is projected to increase to 62% by 1980, as against a reduction of cotton consumption from 46.1% in 1973 to 30% in 1980. In respect of exports also, synthetic materials are projected to increase from 11,000 t in 1974 to 47,000 t in 1980, while cotton exports should also increase to around 175,000 by that year.

29.3 Imports of textile machinery rose from Ps 494 million in 1968 to Ps 1286 million in 1972. Most of the equipment was imported from the Federal Republic of Germany & the USA, though sizeable imports also take place from Great Britain, France, Italy & Japan. Total imports during 1970-4 were of the order of Ps 6100 million. For the periods 1976-80 & 1981-5, it is projected that imports of textile equipment would increase to Ps 9323 million & Ps 14015 million respectively. The projections under the principal subheads are given in Table III annexed to Chapter III.

29.4 The techno-economic study reviewed the principal categories & types of textile equipment from the viewpoint of manufacturing potential in Mexico. These included (a) extension machines (b) picker & lap machines (c) carding & combing machines (d) draw and & roving frames (e) ring-spinning frames (f) open-end spinning machines (g) twisting machines (h) cone-winding machines (i) sizing machines (j) looms (k) circular knitting machines & (m) auxiliary equipment. Texturizing machines & finishing machines, including all types of dyeing machines were also considered. Each of these machine categories was considered from the viewpoint of various criteria such as present & future market potential, versatility, export possibilities etc. The following conclusions were arrived at in the study: (i) in respect of spinning equipment, it was

considered more appropriate to commence with domestic production of conventional ring-spinning equipment, instead of open-end spinning in the present stage of technological development of the latter (ii) the manufacture of looms should not be considered for the present because market penetration to the extent of 600-700 looms per year would be difficult in view of the large variety of looms being used & the overall limited size of the internal market. It may be possible, in the future, to consider shuttle-less looms for domestic manufacture (iii) it should be practicable to manufacture winch becks, jets, yarn dyeing equipment, stenter frames, jiggers, foulards, continuous dyeing ranges, continuous bleaching ranges & continuous washing ranges in two units, one for dyeing equipment & one for finishing equipment (iv) the manufacture of twisting machines can be undertaken with ring spinning frames (v) textile equipment which was not recommended for production in the initial stages included extrusion machines, picker & lap machines, combing machines, draw frames, flyers, automatic cone-winders, beamers, sizing machines & texturizing machines, though some of these machines could be considered in the next phase of textile equipment manufacture.

29.5 The techno-economic study, therefore, recommended only the manufacture of ring-spinning frames & certain dyeing & finishing equipment in the first phase of textile equipment manufacture. In respect of ring-spinning frames, the suggested specifications of the machine were 396 spindles, with main ring 52 mm & centre distances 75 mm.

29.6 The pre-investment study for the production of ring-spinning frames indicated that a total capital investment of approximately Ps 58 million would be required in two production phases. Working capital would be necessary to the extent of Ps 65 million. Production in the first phase (3 years) would reach 118 units by the third year & would be able to be increased to 264 units by the 7th year. Exports are anticipated at 20% of production. The project would be financially very viable with net profits of over Ps 35 million in the 5th & 10 years respectively. The internal rate of return would be well over 25%. Total annual value-added would average around Ps 33 million, while the entire production would be in the nature of foreign exchange savings. As for dyeing & finishing equipment, the pre-investment study indicates that capital investment in these two projects would be Ps 10 million & Ps 15 million respectively & both the projects would be financially quite viable. The total capital investment of the three categories of textile equipment recommended for production in Mexico was therefore estimated to be Ps 83 million.

29.7 The investment promotion follow-up in respect of textile equipment production was rather limited, as a proposal was received in NAFINSA from a local entrepreneurial group later in 1975 & this has since been under consideration in another branch of Nacional Financiera.

Equipment for the iron & steel industry

30.1 The production of iron & steel in Mexico has developed fairly consistently with internal demand growth over recent decades. Production in 1975 in the steel plants & semi-integrated units may be seen from the following table.

Steel Plant	TABLE XII *	
	Production in 1975	Installed capacity by 1976
Altos Hornos de Mexico	2.23	3.75
HYLSA	1.30	1.70
Fundidora Monterrey	.83	1.65
Tubos de Acero de Mexico	.36	0.5
SICARTSA		1.25
Semi-integrated	.98	1.0
	5.65	9.40

By 1980, it is projected that steel production in Mexico would increase to 12.5 million tons. Expansions already undertaken indicate that capacity would increase to 10 million t by 1978. For the period after 1980, various estimates have been made. It is considered that production by the year 2000 may well be of the order of 46 million t.

Source: Cámara Nacional, "La Industria Siderúrgica Mexicana en 1974"

30.2 In view of the projected growth of the steel industry, as also the increasing need for replacement of equipment & parts in existing steel plants, it is considered that the requirements of iron & steel plant equipment would be very substantial. Most such equipment is being imported at present and domestic production has been largely confined to spare parts & consumable hardware for the existing plants. A techno-economic study was undertaken through a UNIDO specialist, assisted by counterparts from NAFINSA with a view to (a) define the overall demand for steel plant equipment for the period upto 1981-90 & identify the specific items of such equipment which could be undertaken for manufacture in Mexico & (b) outline the phased programme of manufacture of such identified items, including determination of investment requirements etc. This study was commenced in June 1975 & while the first part of the study has been concluded, the second portion will be completed by May 1976. The principal conclusions of the first part of the study are as follows: (i) The demand for steel by the year 2000 is projected at 46 million t. This would result in annual per capita consumption of steel rising from 105 kg in 1975 to 350 kg in 2000, which is not considered unreasonable in view of the fairly rapid pace of industrialization (ii) The pattern of steel consumption would undergo some modification by the year 2000 with the consumption of sheets rising to 36% (31.2% in 1965-73) steel plates to 18% & consumption of other products such as seamless pipes, wide rods, bars, light & heavy shapes & rails and accessories changing to some extent. (iii) For the period from 1980 to 1990, iron & steel production is projected to increase by over 10 million tons (including 0.5 million t of alloy steel) (iv) For increased production of this order, about 1 million tons of equipment would be required, starting from material-handling to despatch of finished products & including services & utilities such as a captive power plant, oxygen plant etc but excluding steel structurals. Of this total weight, the tonnage of rolling mill equipment would be around 250,000 tons, including continuous casting & processing lines, while coke oven equipment & steel making equipment would account for 125,000 t. The remaining tonnage would cover a wide variety of equipment & auxiliaries such as handling equipment, pumps & compressor housing, oxygen plants etc. (v) It is considered that the manufacture of heavy rolling mills may not be practicable in the first stage of steel equipment production & that attention should be concentrated on light & medium rolling machines & processing equipment in the first instance. This would cover around 60% of the tonnage for rolling mill equipment &, in terms of weight would go up to about 130% t annually. It is estimated that about 14 rolling mills would be required, of which 8 would be in the medium category, including billet mills, wire rod mills,

narrow hot & cold strip mills, with necessary roller tables, transfer beds, cooling beds, etc. Finishing & processing lines would include items such as straighteners, saws, shears, bundling equipment etc & annealing furnaces, picking lines, galvanising lines, corrugating lines etc. (vi) The manufacture of coke-oven equipment has not been recommended in the initial stage, as this is considered to involve different technology.

30.3 Though there are considerable fabrication facilities in Mexico, most of the equipment for steel plant expansions currently under way have been, and continue to be, imported. Projections for imports during the period 1976-80 & 1981-85 are estimated at Ps 5500 million & Ps 9 000 million (1974 prices). Most of such imports would relate to equipment directly utilised in steel making & not extending to auxiliary facilities. It is estimated that, of the projected volume of imports in 1981-5 the average annual imports of medium & light rolling mills and and processing & finishing equipment during 1981-5 would be of the order of Ps 475 million or Ps 2375 for the 5-year period. It should be possible to replace almost this entire volume of imports by a new production facility.

30.4 It is accordingly considered necessary that a new production facility should be set up in Mexico for light & medium rolling mill equipment & processing & finishing equipment for new steel plants & extensions. Though part of the requirements can be met by expanding some of the existing facilities, this may not provide a satisfactory solution as it may require substantial modification of the production programme of such enterprises & would nevertheless leave a substantial production gap. In any event, a major new facility is required & it would be desirable for such a new facility to cover at least the requirement of 1300 t annually of the equipment referred to above. In addition, such a facility should also cover the annual requirements of spares & replacements to a substantial extent. The total projected demand of spares & replacements for a steel production capacity of 10 million tons by 1980 over the period 1981-90 is estimated, in the techno-economic survey, at around 28,000 t annually. It is suggested that 40% of such capacity could also be covered in the proposed new facility. Thus, the total production capacity of the new facility should be planned for 25,000 t annually. Such a production level should be able to be achieved over a 2-3 year period after commencement of production by 1979-80 if an investment decision is taken during 1976-7.

30.5 The capital investment for a new facility designed to produce 25,000 t annually of such equipment is estimated to be Ps 900 million. Such a facility would include separate shops for rolling mill products, finishing & processing equipment & spare parts & replacements. Provision should also be made for a forge shop, with forging capacity upto 3 tons of individual pieces & including a 1000 ton press & a hammer of 3 tons. The forge shop is estimated to cost around Ps 60 million, and would be very vital part of the facilities & could also cover the requirements of forgings upto this weight, for other industrial sectors. The requirements of steel & iron castings for the new facility would also be fairly large. It is considered, however, that this requirement could be met by existing steel foundries. A major new gray-iron foundry has been separately recommended for establishment, as part of the Capital-Goods Programme, & this would effectively cover the requirements of iron castings for the steel equipment plant.

30.6 The capital investment projected for the new facility for steel plant equipment is undoubtedly very large & constitutes the largest single production unit in the Capital Goods Programme. With the established demand for spares & replacement & the inevitable demand for rolling mill & allied equipment during 1981-90 and thereafter, this heavy investment is considered essential in a major new production facility. It may be emphasised that the heavy machine-tool complex, which would be established in such a plant, could be utilised for production of a variety of other equipment, including foundry equipment & machinery for other industrial sectors, as also machinery spares & replacements for such sectors. Such a variety of demand would effectively cover any surplus production capacity that the proposed new plant may have, during any temporary period.

30.7 With an investment of Ps 900 million, it is projected that annual production value of the proposed new plant, when working at relatively full production capacity would be around Ps 900 million on a 1:1 ratio which is considered reasonable for plants of this nature. This would render the project economically viable within a 5-7 period. The establishment of such a major production facility would undoubtedly cover a significant production gap in the economy & would pave the way for self-sufficiency in a key & vital growth sector.

30.8 Negotiations have been initiated with a reputed British group, having extensive experience in steel plant engineering & equipment production, for participation in a project for designing

**& manufacture of steel plant equipment in Mexico. Such collaboration is considered essential, either from the above group or from some other international group, as steel plant engineering would be closely related to the designs & specifications of the various types & categories of equipment involved. Foreign collaboration could take the form either of participation in the entire engineering design & production programme for equipment or only in the former. It is, however, essential that domestic capacity in steel plant engineering & designing of plant equipment should be developed as rapidly as possible. Such an engineering & design organisation can be developed fairly soon, as a nucleus of personnel already exists in the various steel plants. Close co-ordination will, however be necessary between the various steel plants, not only in terms of assessment of requirements of equipment & spares, but also in the rapid development of design & engineering facilities which can be utilised by all these plants.**

### Equipment for chemical & petrochemical industry

**31.1 The chemical & petrochemical industry is one of the most dynamic growth sectors in Mexico. The sector can be viewed under the heads of (a) petroleum operations, including drilling & refining & (b) basic and secondary chemicals including organic & inorganic chemicals, fertilisers and pharmaceuticals. While petroleum operations are conducted entirely in the public sector through Petroleos Mexicanos (PEMEX), the chemical and petrochemical industry is divided among the public sector (PEMEX & GUANOMEX, which produces fertilisers & pesticides) & the private sector which covers a wide range of products, including organic chemicals, secondary petrochemicals, synthetic resins, fibres & rubber, agro-chemicals & pharmaceuticals. The average growth rate of this sector during 1971-4 was between 9.5 to 10% & the industry contributed over 7% of GDP during this period. Despite the massive investments both in the public & private sectors, substantial imports of chemical products are continuing.**

**31.2 A techno-economic survey of the growth trends in the sector & the equipment requirements in the next few years was conducted through an UNIDO specialist during Oct. 75 to Jan. 76. Equipment for this sector was broadly classified under the heads (a) pressure vessels, including heat-exchangers, distillation & other towers, columns, vessels, drums etc. (b) storage tanks, such as gas holders & tanks & (c) process equipment such as fired process equipment e.g. reactors, heaters, tubular furnaces, condensers, wasteheat recovery systems etc. process equipment such as cooling water equipment, boiler feed water equipment & equipment for waste.**

water. The principal projections & conclusions of the survey are as follows: (i) It is estimated that 7-10 refineries of a size of 150,000 BPSD would be set up. Each refinery is estimated to require about 53,000 t of equipment, including heat exchangers (1500 t) reactors (1500 t), columns (2000 t), storage tanks (20,000 t) & piping & super structure (28000 t). An average annual figure of Ps 1000 million would be required for such equipment. (ii) The programme of PEMEX for the production of basic petrochemicals is estimated to cost over Ps 14500 million during 1977 to 1982 & about Ps 45,000 during 1983-2000. Assuming the chemical equipment requirements at around 60% of this figure, the annual demand for chemical equipment during 1977-85 would be around Ps 1600 million (iii) The programme of GUANOMEX envisages a total investment of Ps 18,500 during 1974-2000. Assuming 60% equipment needs, the annual equipment requirements during 1977 to 1985 would be around Ps 450 million. By 1976 GUANOMEX production capacity has extended to Ammonium Sulphate (514,000 t), Ammonium Nitrate (166,000 t) urea (433,000 t) & superphosphate, complex & mixed fertilisers, besides sulphuric acid (650,950 t), nitric acid (150,000 t) phosphoric acid (74,500 t) & other chemical products. A major expansion programme is envisaged over the next two decades, in view of the rapidly-increasing need for fertilisers & pesticides by Mexican agriculture. (iv) The private-sector chemical industry is growing rapidly & investments during 1976-80 are estimated at around Ps 30,000 million, which would result in a demand for chemical equipment to the extent of Ps 16,000 for the 5-year period, or around Ps 3200 million annually on an average. It is considered that an annual demand of this order would continue for the period beyond 1980 also. The private sector chemical industry had a total accumulated investment of over Ps 30,000 million by 1973 (Ps 17,883 million after depreciation). It is estimated that such accumulated investment may go upto Ps 64,000 million by 1980. A major project completed recently (1974) was the DMT plant (172,000 t/a) of PETROCEL near Tampico. Major plants under construction include a hydrofluoric acid (125,000 t) plant at Matamoros, a phenol plant (25,000 t), a soda ash plant in Tehuantepec, a new caustic soda plant, also in Tehuantepec, a caustic soda plant near Guadalajara, a titanium dioxide expansion project, a plant for production of TPA (135,000 t) in the Isthmus, besides a number of other projects which have been approved in principle by various private-sector groups (v) The equipment requirements of the chemical sector have to be dovetailed with the machinery & equipment needs of electricity generation through thermal & nuclear stations. Such requirements include high pressure boilers, high-pressure vessels, condensers, feedwater, heaters etc. The specific figures in this regard have not, however, been incorporated as these have been separately dealt with in para 15 of Chapter I". (vi) In addition to the needs of the Mexican economy some projections have been in the techno-economic study regarding the Latin American market as a whole. It is estimated that



**new investments in oil refineries in Latin America during 1980-2000 would be of the order of Ps 300,000 million (average annual investment would be around Ps 15,000 million) of which about Ps 7500 million would be the annual equipment requirements. Similarly, average annual equipment requirements in other countries in Latin America is estimated to be Ps 7500 million for petrochemical plants in the public sector & Ps 10,000 million for chemical & petrochemical plants in the private sector. These massive requirements together with that of hp equipment for power stations, gives some idea of the export possibilities for such equipment.**

**31.3 The techno-economic survey indicates, therefore, that the demand for equipment for the chemical & petrochemical industry in Mexico would be of the order of Ps 6250 million annually after 1980 & possibly upto the year 2000 excluding the requirements of similar equipment for the thermal power generation programme. It is also considered that rapid growth of this sector in other Latin American countries could present considerable export possibilities. For the 5-year period 1981-5, the total internal demand would, therefore, be of the order of Ps 31,250 million, for the equipment categories mentioned in para 31.1. As against this demand, domestic production is likely to prove very inadequate. While 47 enterprises are identified as producing chemical process equipment many of the units are relatively small. Detailed production & sales figures could not be obtained from all these enterprises, but the survey showed that most of the enterprises had a fairly satisfactory order-book, though productivity tended to be low in some cases. Sales for 1974, however, for 7 of the major units totalled only Ps 1055 million, such sales including power boilers & some equipment unrelated to the chemical industry in some cases. Nine domestic enterprises are producing heat-exchangers of which the most prominent are Swecomex, Avante Clermont & Metalver. Reactors are being produced by Avante Clermont, Metalver & Consorcio Industrial, distillation columns by Industria del Hierro, Avante & Swecomex, while superstructure is being done by 5 enterprises. Fifteen units are producing liquid storage tanks while four units are producing spherical gas storage vessels. Despite the large number of domestic enterprises in this field, imports have continued to grow as domestic capacity is falling far short of demand. The extent of the shortfall is difficult to define accurately but it is estimated that total domestic production of specific equipment for chemical plants etc, as discussed above, would after expansions not exceed Ps 12,500 during 1981-5 or a maximum average production of Ps 2500 million annually. This would still have a production gap of around Ps 18,650 million for 1981-5 or Ps 730 million annually for this period.**

31.4 In Chapter III, it has been indicated that equipment imports for the chemical industry were of the order of Ps 7610 million during 1970-4 but are projected at Ps 15,360 million during 1976-80 & Ps 29,900 million in 1981-5. These projections follow a somewhat different pattern as they also include projected imports of a number of common-use machinery such as pumps centrifuges & compressors (Ps 3680 million during 1981-5), internal combustion engines (Ps 2965 million during 1981-5), steam engines & gas turbines etc (Ps 290 million in 1981-5) etc. The total projected imports of common-use machinery & equipment, including electrical items for the chemical & petrochemical industry, would be over Ps 11000 million during 1981-5 while equipment items specifically for the chemical & petrochemical industry & covering the categories discussed in para 31.1 would be around Ps 18,650 million for the above period.

31.5 The estimated production gap of around Ps 3730 million annually during 1981-5 is unlikely to be covered by expansions of existing production units. Such expansion can cover around 30% of existing capacity, which is estimated at around Ps 17500 million annually. It is considered necessary that additional production capacity is created to cover the gap. It has not been possible to prepare a pre-feasibility study in respect of such a new facility or facilities & this needs to be done, as early as possible. Such a study would need to define the broad gaps in respect of each category of chemical equipment, so that a suitable product mix for the proposed new plant or plants can be defined. For estimation purposes, a conservative provision of Ps 350 million in the first phase is suggested for new production facilities, designed to produce various categories of specific equipment for the chemical & related industrial sectors. Since such new facilities should develop export capability as soon as possible, it would be desirable to set up such plant in collaboration with one or more reputed international chemical equipment manufacturers.

#### Other heavy - mechanical equipment sectors

##### Cement, pulp & paper & sugar :

32.1 It was proposed to undertake a survey of the requirements & detailed production gaps in respect of certain other industrial sectors requiring heavy mechanical equipment. The most important of these is cement & pulp & paper. Unfortunately, owing to fund restrictions, no UNDP/UNIDO expert assistance could be obtained so far & this needs to be considered in the future. The import projections in respect of cement equipment

(Ps 1500 million & Ps 2600 million during 1976-80 & 1981-5) & pulp & paper equipment (Ps 2415 million & Ps 4200 million during 1976-80 & 1981-85) indicate that there is likely to be sufficient potential for increasing machine-building capacity for these two branches. To some extent, the plants recommended for steel plant equipment & for hydro turbines would meet the demand for heavy equipment in these sectors also but this aspect would need detailed study. In respect of the sugar industry most of the equipment needs are already being manufactured in Mexico & likely machinery imports during the next 10 years would be of a marginal nature & relate principally to special-purpose machines or materials.

#### Mining industry & non-ferrous metals industry

The requirements of the mining industry, with projected imports of Ps 1200 million & Ps 1900 million during 1976-80 & 1981-5 respectively does not represent a significant production gap which would justify additional manufacturing facilities, as much of this provision would relate to sophisticated, special-purpose equipment. The non-ferrous metals industry would also fall in the same category, though part of the equipment gap could be covered by the additional plant facilities for steel plant equipment & for hydro turbines.

#### Mechanical machinery industry.

32.2 The mechanical machinery industry is projected to require significant imports during the next 10 years period (Ps 7400 million & Ps 11,100 million in 1976-80 & 1981-5 respectively) Most of this requirement, however, would be in the form of sophisticated & special-purpose machine tools which would not be practicable to manufacture in Mexico in the immediate future.

#### Construction equipment

32.3 Very significant imports have been projected for the construction industry (Ps 9600 million & Ps 15,600 million respectively). As pointed out in para 8.9, however, most of this demand relates to special-purpose tractors & heavy earth-moving equipment, which have been excluded from the purview of the Capital-Goods Project. In fact, in an earlier survey by the UNIDO-NAFIN Group, it was noted that the manufacture of construction equipment had made rapid strides in Mexico with production value rising from Ps 55 million in 1964 to around Ps 200 million in 1971. The growth trend has, by & large, continued to be fairly satisfactory but, with the high-degree of mechanisation used in construction activities in Mexico, the imports of heavy special-purpose construction equipment would necessarily have to continue, as domestic manufacture of excavators, crawler

tractors, industrial tractors, motor graders, compaction equipment & the like may not be economically viable above a certain range. A number of enterprises are producing construction equipment in the country & there is little justification for any additional production facility.

### Agricultural equipment

33.1 The requirements of agricultural equipment were examined carefully during the earlier phase of the Capital-Goods Project & it was considered that the agricultural equipment industry has grown & was growing rapidly\* & that imports in this category primarily relate to special & sophisticated machines which it would not be viable to produce in Mexico. The revised import projections confirm the earlier view. Projected imports of Ps 6000 million in 1976-80 & Ps 7600 million in 1981-5 are spread over a wide variety of sophisticated agricultural machinery & equipment, which would not be economically manufactured in the country. There are already 8 enterprises engaged in tractor manufacture, while a number of units are producing sub-sievers ploughs harrows, fertilisers spreaders etc. together with the simpler types of harvesters, baling presses, loaders & the like. The production of more sophisticated agricultural equipment should be left to be undertaken by domestic manufacturers as & when domestic demand for the particular categories of such equipment grows to an adequate extent.

### Food-processing equipment

33.2 This is a significant machinery-consuming sector though it covers a very wide field of equipment which may be difficult to group together in viable manufacturing projects. It was proposed to undertake a detailed techno-economic survey of this sector during the first half of 1976 but this has not been possible owing to fund restrictions on the part of UNDP/UNIDO. The revised import projections indicate that imports of such equipment would be of the order of Ps 4800 million & Ps 7000 million during 1976-80 & 1981-85 respectively. Since the unit values of food-processing machinery are not unduly high, imports of this magnitude would indicate that certain categories of such equipment would have adequate potential for domestic manufacture in Mexico. It is suggested that a techno-economic study of this industrial sector should be undertaken as early as possible.

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\* Report of Phase I-B

Electrical machinery industry

34. An industrial sector which is projected to have sizeable imports during the next 10-year period would be the electrical machinery production sector. Since a number of projects are under consideration for the production of heavy electrical equipment, the equipment demand for these units is bound to be fairly high. Most of such demand would, however, be in the form of sophisticated machine tools & heavy equipment which it would not be practicable to produce in Mexico in the immediate future. The import projections for this sector would therefore have to be left uncovered.

35. The above survey of specific industrial sector is not exhaustive. A sector where machinery demand is growing rapidly is the printing industry. Projected imports for this branch are Ps 2485 million & Ps 3700 million respectively for 1976-80 & 1981-5. Printing equipment is, however, fairly sophisticated & may be difficult to undertake immediately at present. Such equipment may perhaps be left over for the next stage of machine-building, particularly after machine tool manufacture has developed considerably. Another specific branch is that of rubber processing. Here again, it may be appropriate to consider domestic production in the next stage of capital goods development. It is important to emphasise that the various machine-building projects being recommended would comprise a comprehensive range of fabrication & machining facilities, which could be usefully utilised for the production of a wide range of machinery & equipment for other industrial sectors also.

36. In the light of the above, it is considered necessary that additional production facilities should be set up to cover the equipment requirements of the specific industrial sectors discussed in this chapter. The recommendations in this regard are summarised below.

TABLE XIII in million pesos

<u>Sector</u>	<u>Total Proposed capital investment</u>	
1) Textile equipment (selected categories only)	83	Under negotiations by NAFIN
2) Equipment for the iron & steel industry (including forge)	900	For consideration
3) Equipment for the chemical industry (including refining petrochemicals & fertilisers)	350	Detailed study to be prepared
<b>T O T A L</b>	<b>1233</b>	

## VII. GENERAL APPRAISAL OF PROJECT APPROACH AND ACTIVITIES

37. - *The capital goods sector is essentially a part of the metal-working or metal-transformation branch & any detailed programming of the former should necessarily be part & parcel of an overall programme for the metal-working branch as a whole. Similarly, the programming of the metal-working branch needs to be integrated within an overall programme for the economy, so that the inter-relationships, priorities & resource inputs-outputs fall into clear perspective. In the absence of any programmed approach for the metal-working branch as a whole, any detailed sectoral programming such as for the capital-goods sector is faced with serious practical difficulties, particularly when the objective is to achieve the rapid growth of this sector through the implementation of specific manufacturing projects. In such a situation, recourse has necessarily to be taken, as was done in this project, to a broad identification of machinery products & product groups followed by techno-economic studies of such groups, as a base for investment promotion & programming.*

38. - *A number of other studies conducted under the aegis of international & other agencies, have emphasised the need for preparing a comprehensive input-output model for the metal-working sector, & various approaches have been adopted in different countries. In many socialist countries, material balances are prepared, though on a fairly aggregated basis through the application of standard, technical norms. These are then followed by detailed project studies, with necessary reconciliation & adjustments being effected, to the extent possible, in the course of actual implementation. In India, the instrument of industrial licensing is sought to be utilised to ensure that the input-output relationship between domestic capital & material resources & scarce foreign exchange does not get unduly distorted & is maintained in accordance with a broad system of industrial priorities. In some countries such as Hungary, a linear-programming model includes various sub-models relating to the metal-working sector & covering 133 individual products. In Czechoslovakia, it is understood that programming of the industrial sector extends to a combined matrix of 130 x 130, with a subdivision matrix of 99 x 99 for heavy industry. The preparation of a comprehensive matrix of this nature which, in turn, can be applied to investment decision-making would be a very difficult & time-consuming task in a country such as México, where collection of information presents serious problems. An aggregated approach, on the other hand, become too generalised for practical application & an earlier model prepared in respect of the metal-working & certain other sectors of the*

*Mexican economy (\*) could not be effectively utilised at all in the present project.*

39. *In an U.N. study dealing with programming for the metal-working sector (\*\*) a provisional classification has been made of the major manufacturing activities of this sector. This extends to 93 branches & an illustrative list of products is given for each branch. Even this illustrative list covers over 400 products, including a large number of consumer-goods items. Excluding office machinery & household equipment, the classification extends to 64 branches of machinery, including transport equipment, while the illustrative product list of these branches covers 289 items. Such a product list, if made exhaustive, could extend to thousands of items. The preparation of a matrix for such a list of products would be an extraordinarily complex task, the results of which in terms of investment application decisions would be hardly commensurate with the enormous effort involved. Even a 64 x 64 matrix would prove very complicated though the aggregation in such a case would be so broad as to render its use extremely limited in respect of investment decisions and determination of priorities.*

40. *The nature of capital goods production is also such that linear programming methods are difficult to apply in a number of cases. Though long-run production items can be identified in the machine building sector as mentioned in para 5.9 above, many capital goods enterprises tend to the multi-product in nature. Since such enterprises usually comprise of fabrication & machining shops of various sizes & complexity, the equipment in these shops can be utilised for various operations. A complex machine tool can, for example, be utilised for a number of individual alternative products or operations and optimum utilisation of capacity may well include a number of machining & other operations, which may be quite distinct from one another. Consequently, the order book for one year may be considerably different from that of another & is often inter-related with the degree of subcontracting work either farmed out by the enterprise or undertaken by the enterprise. Flexibility in production is a significant feature of most machine building enterprises & the concept of "capacity" has to be viewed differently from that of, say, a process industry producing a certain defined output per day. Capacity utilisation*

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*(\*) A.S. Manne: Key sectors of the Mexican Economy in "studies in Process Analysis: Economy wide Production Capabilities". ed by A.S. Manne & H.M. Marcourtz, 1963. Cowles Foundation Monograph No. 18, Wiley, New York.*

*(\*\*) "Planning & programming of the metal-working industries with a special view to exports. 'ID 23 Vol II. United Nations New York, 1972.*

is usually viewed in terms of total annual output of an enterprise, though this can be broken down in terms of major machine groups for better production planning in future. Where such total output is comprised of a number of products & processes & where the overall reduction in production costs or increase in profitability is attributable to a number of products & processes, linear programming becomes for more difficult to apply for a number of such enterprises. In an extensive research study undertaken in the University of North Carolina Centre for Social Studies (\*) the approach adopted was to consider groups of machines such, as a forge shop etc. as "resource elements", while the outputs were specific machine products. The approach was further developed in the U.N. study (\*\*) by adopting 53 resource elements against basic production processes such as forgings, castings, machining, heat treatment & the like & then, using these resource elements as inputs, preparing a sample of specific machinery end-products. The above approach undoubtedly is very interesting but is difficult to apply for an economy as a whole where detailed information relating to a large number of enterprises would be very difficult to obtain. A uniform "resource-element" for the various processes would also be almost impossible to define with any degree of accuracy in a country like México. Other assumptions in the study also make it extremely difficult to apply in terms of practical investment programming.

41. Another important aspect to be considered is the relationship between the results of research studies & practical investment decisions, particularly in a market economy such as that of México. Most research studies are necessarily predicated on the assumption that investment decisions follow a clearly-defined & logical pattern of economic priorities, both national & of the enterprise in question. Often as not, this is not the case, particularly in a market economy. National priorities often do not coincide with the priorities of private enterprises & a different approach is needed to bridge the gap. Whereas a programmed approach can be put into practice fairly effectively in a centrally-planned economy, investment decisions in a market economy are necessarily governed by strictly commercial considerations. Experience in this project itself has shown that where the economic priorities are clearly established such as in the case of transformer manufacture in México, investment action & decisions have nevertheless proceeded slowly & haltingly whereas in the case of a fairly sophisticated machine-tool manufacturing project, the investment has been far speedier. The problem of allocating inter se priorities between different projects faces the same limitation. Whereas

(\*) The approach adopted in the UNC study has been discussed in detail in the U.N. publication. Ibid.

(\*\*) Ibid.



*a particular manufacturing programme may have higher priority from national as well as commercial considerations, this may have little meaning, unless such priority is backed by adequate investor response vis a vis another project which may have less priority on broader considerations but where the investor response is far greater. Consequently, though the various projects in the capital goods sector can be allocated different inter se priorities, this could be of very limited practical significance. The approach adopted in the Project was pragmatic in that promotional activities for all the identified projects were pursued more or less simultaneously.*

42. *It is, by no means, suggested that a detailed input-output programming model for a particular year or period for the metal-working sector in México would not be a useful exercise. In fact, this would be extremely valuable, & a sub-model or models for various machinery sectors would constitute a very useful tool, both to highlight overall priorities over a period of time & to review the growth trends of machine building sector during a particular period. It could, over a period of time, also be an useful tool in project identification as growing demands are identified on particular production capacities such as for production of cranes or conveying equipment. The effect of new projects would also be seen more clearly in terms of impact on others. Inter-industry linkages would also be more clearly apparent. However, such detailed programming in terms of an input-output model involving thousands of products would, as pointed out above, be an extremely complicated task & needs to be considered primarily on a long-term basis. What is necessary to emphasise is that the Capital Goods Project, in its very nature, should not be construed as a detailed exercise in sectoral programming based on any input-output model. From this viewpoint, the project must be seen as limited operation, seeking principally to identify the principal gaps in machine-building production in the country & attempting to cover such gaps through investment promotion activities. To the extent that the specific techno-economic studies have defined various inputs required for a particular manufacturing programme, the inputs have been analysed in terms of availability & cost. For example, detailed studies relating to the production of castings & of gears & speed reducers were conducted as these items were considered to be key inputs likely to be in short supply if an extensive machine-building manufacturing programme was undertaken. Most other material inputs would not, however, pose a major problem in the first-phase investment programme of the Project*

43. *It may be said of the Project that it was principally an exercise in import substitution. This is only partially true though it needs to be emphasised that most national programmes for machinery production in developing countries have to be initiated on the basis of import substitution. There are un doubtedly instances such as in the island economies of Hongkong or Singapore, of precision products manufacture solely for exports. Such manufacture has, however, developed*

within a particular policy package of welcoming foreign investment even by way of wholly-owned foreign subsidiaries & combining such policies with the special endowments that these economies possess. Despite this, however, it needs to be noted that wholly export-oriented capital-goods products are manufactured only to a limited extent in such economies & in other developing countries which are attempting to develop export-oriented industries. In such of these countries where capital-goods production has grown rapidly, such as Brazil, Argentina & India, the initial base has invariably been the home market & export capability has developed, sometimes very rapidly, as the machinery products get established in the internal market. What is essential to recognise, in the context of import substitution, is that such substitution cannot be economically pursued beyond a point & it is necessary to define such limits in each subsector. This is what has been sought to be done in the various techno-economic studies in this Project.

44. The brief discussion in the above paragraphs of some of the principles related to capital goods planning & production is necessary in order to view the Capital-goods Project in its correct perspective. The pragmatic approach adopted in the Project is fully consistent with the basic objective of the Project, which was to develop the capital-goods industry in Mexico. A project of this nature must, in the ultimate analysis, be judged by the investment & the investor response that it is able to generate. From this viewpoint, the Capital-goods Project must be considered to be eminently successful. Not only have a number of concrete projects been identified & are in various stages of negotiation but, even more important has been the great stimulation of interest among Mexican industrial enterprises and a large number of reputed foreign manufacturers in machine-building projects in Mexico.

45. As indicated in the previous chapters, the first-phase investment requirements for the capital-goods sector in Mexico would be of the order of about Ps 3000 million i.e. over US\$ 240 million \$. For convenience, a summary of the projected likely investment for each of the three major categories of capital goods production is given below:

**TABLE XIV**

	<u>in million pesos</u>
a) Projected additional capital investment for electrical machinery & equipment	810
b) Projected additional capital investment for mechanical equipment of common use	.
c) Projected additional capital investment for mechanical equipment for specific industrial sectors.	<u>1321</u>
<b>Total</b>	<b>Ps. 3 011 million</b>

46. As described in previous chapters, many of the projects are already in a stage of fairly advanced negotiations while investment decisions have already been taken in some cases. The total output in 1980, by when most of the projects should be in production is likely to be of the order of Ps 6330 million. This would constitute over 25% of machinery & auxiliary imports in 1980 projected at Ps 28 million for the related & 38 identified branches and would have a very favourable impact on the balance of payments in 1980 & even more so in successive years. There would be direct savings of foreign exchange of at least 60% of this figure as only a certain volume of key components would have to be imported, which would progressively decrease during the early 1980s. The direct employment opportunities for skilled, semi-skilled & unskilled categories generated by the above investment programme would be for 3500 to 4000 persons, the actual number depending on the final nature of investment in each case. Inclusive of secondary & tertiary employment, the employment impact is likely to be well over 9000 by 1980.

47. A very significant impact of the projected investment programme is in the growth of skills that would be generated. Most of the above projects involve a high incidence of trained skills. In the detailed studies relating to each project, considerable emphasis has been given to the training aspect & specific financial provision has been sought to be provided for this purpose. In the case of expansion projects, the training requirements will be easier to meet &, in most cases, programmes of retraining would be involved. In new projects, initial recruitment would be a mix of skilled & semi-skilled workers having adequate mobility to move to new project sites & locally-recruited personnel who would be given initial training in the plant itself. All in all, the overall impact of the projected investment programme in terms of growth of skills would be very considerable. A problem to be considered in this context is whether any of the projects would need to be reviewed owing to non-availability of suitable personnel. This is not considered a serious likelihood. There is already a substantial pool of trained & semi-trained personnel which would constitute the nucleus around which specific training programmes would need to be initiated by the new or expanded enterprises. The cost of training would, however, constitute a substantial burden on some of new enterprise in particular & this aspect needs to be considered from a policy viewpoint.

48. In reviewing the status of the various investment propositions discussed in the previous chapters, it is necessary to consider whether the promotional activity & investment decision-making has been an unduly prolonged process. In some cases, this undoubtedly has been the case. This has occurred for a number of reasons, some of which have been discussed in the next chapter. It must, however, be stressed that investment promotion & investment decisions in machine-building projects, based on private & mixed investment is inevitably a fairly slow process. In some developing countries, such as Egypt, Iran & India, capital goods production

has been largely undertaken in the public sector through governmental undertakings, partly because of their overall importance & significance in the economy & partly because private investment, foreign & domestic, is often not adequately forthcoming in so far as this sector is concerned. In the Mexican project, the pattern of investment considered for most of the projects has been of private-sector financing, either foreign or domestic or both, with Nacional Financiera undertaking necessary participation to the extent necessary to cover any investment resource gaps. In this pattern, investment decision-making inevitably becomes a function of more than one party & takes considerably longer. While the example of the machine tool project with collaboration from an U.K. company is among the most prolonged, a period of 1 to 2 years has necessarily to be allowed. Much of this time is taken in reviewing market estimates & preparation of a final feasibility study, though negotiations relating to investment & technology supply have also extended over several months in many of the cases.

49. The capital-goods development programme must necessarily be viewed as a continuing programme over a period of time. Whereas the first-phase investment outlined in this report would constitute a strong foundation for the future growth of this sector, these projects would in turn generate new input demands, & a series of further linkages, backward & forward, would necessarily develop over a period of time.

## VIII. POLICY ASPECTS OF CAPITAL GOODS MANUFACTURE IN MEXICO

50. While it may not be practicable to formulate a package of policies designed solely for one sector of the manufacturing economy, however important this may be, it is nevertheless necessary to recognise that the accelerated growth of the machine-building sector in Mexico poses certain special and distinct problems of its own. These have emerged in sharper focus in the course of implementation of the Capital-Goods Development Project, both during the preparation of the various techno-economic studies & in the process of investment promotion & programming. A solution to these problems must necessarily be found within the basic socio-economic policy framework in Mexico & the procedures that these policies entail.

51. The growth of machine-building enterprises in Mexico has, in the past, been rather slow & patchy, when compared to certain other developing economies, such as Brazil, Argentina or India. This has occurred for a variety of reasons. Firstly, the limited domestic market for specific machinery products constituted a major constraint, which was considerably aggravated by the fact that there was relatively little restraint on machinery imports till recently. In fact, with a view to promote overall industrial growth, machinery imports enjoyed considerable concessions, again till fairly recently. Since many of the principal consumers of machinery products, particularly heavy mechanical & electrical equipment have been, and continue to be, governmental agencies & institutions, the purchase policies of these institutions have a direct & significant bearing on the size of the domestic market. Such purchase policies have not been conspicuously in favour of domestic machinery producers; in fact, the opposite has often been the case. Secondly, private-sector domestic investment has concentrated principally on consumer goods & intermediates, where the investment opportunities & returns have been much greater. The nature of capital-goods production, with its relatively higher capital outlay & prolonged gestation period for achieving technological & productive efficiency, have also militated against greater resource channelisation to this sector. Thirdly, the high money cost of capital in Mexico has resulted in limited use of borrowing, which again has constituted a significant constraint for this sector. Fourthly, the policy of import substitution at all levels has resulted in the cost of industrial processed materials & inputs being unduly high & resulting in the cost of the final machinery product being substantially higher than similar imported products. Where such price differential is very significant, it would be unreasonable to expect domestic purchasers to purchase national products. This, in turn, further circumscribes the size of the local market. Finally, there has been no deliberative policy to specifically encourage the growth of this particular sector & its key & vital role in the future industrial growth of Mexico has been recognised fairly recently. Consequently,

*the system of tax & other incentives has no particular orientation in favour of domestic machinery manufacture, nor does the export subsidy programme have any bias for such production, though this is vitally important for expanding the potential markets for such manufacture. It was inevitable, against this background, that capital-goods production in Mexico would follow a largely un-coordinated pattern.*

52. *The fact that most capital-goods enterprises in Mexico are either subsidiaries & affiliates of foreign manufacturers has also had a significant effect on the sectoral growth pattern. Though a number of such subsidiaries have expanded gradually with the growth of the domestic capital-goods market, expansion in many cases has inevitably followed a more global pattern, dictated by the multi-national interests of the company rather than domestic national interest. The typical instance is of companies having a large subsidiary in Brazil, or other Latin American country, limiting the growth of the Mexican subsidiary. Technology transfer in many of these cases has been limited to the immediate need of the domestic Mexican market & there has been little effort to develop export capability except in rare cases, nor has there been much adaptation of technology & techniques by such units. The terms of technology transfer have, in the past, often been very harsh & restrictive & a number of affiliates, while making losses, have nevertheless contributed significantly to the parent organisation. Growth of design & engineering facilities have been extremely limited in many of the cases. In some cases, the transfer of second-hand plants and obsolescent equipment has also constituted a significant constraint to the development of competitive efficiency. While there are notable exceptions in the case of some of the subsidiaries & affiliates, the pattern is often represented by a relatively small or medium sized manufacturing unit, with old equipment transferred after more than two decades of use in some cases & operating with the technological support of the present company even in relatively small & minor technical aspects & functioning principally as the agent & subcontractor of the parent company. This is not only the pattern in this country but in most developing countries & it is only in recent years that this pattern is giving place to aggressive national enterprises in these countries, both in the public & in the private sectors. In Mexico, the growth of domestic machine-building enterprises such as the Industria del Hierro or Svecorex or Metalver is a tribute to the entrepreneurial strength & capability of their sponsors, while the growth of the public sector complexes such as Salagun is a significant pointer to future capital-goods expansion in the public sector also.*

consi-  
or and  
se poli-

53. *Before any major capital-goods production program can be undertaken, it is essential to establish the size of the domestic market to the satisfaction of potential investors. A market study need not necessarily be a highly-detailed, meticulous exercise, with complicated sensitivity models. Where detailed data & information is available, the market*

study can obviously be fairly detailed but most potential investors would be reasonably satisfied with fairly broad demand projections. Experience in respect of a number of investment propositions discussed in the course of the Capital-goods Project amply demonstrated that the market studies prepared for the various sub-sectors was considered to be fully adequate by potential investors. In fact, most of these studies were more detailed than those prepared by potential investors themselves. Such studies have necessarily to be followed by specific feasibility studies by the potential investors, as a number of wider or narrower considerations have then to be taken into account in each case. This is the normal approach in respect of industrial investment decisions & was followed fairly effectively in this Project. From a policy viewpoint, however, an important consideration is the degree of preference that a domestic manufacturer would enjoy, particularly in respect of purchase preference by major governmental institutions & enterprises. This issue was raised in the case of most of the major projects under negotiation & was found to be difficult to answer. This question is basic not only in respect of products such as circuit-breakers where there is only one public-sector consumer, but over a very wide range of machinery products, where the purchase policies of public sector consumers would have a vital role in determining the size of the market. If domestic machinery products have to compete with imported equipment on an open-market basis from the beginning, the scope of capital-goods development would become very limited & would continue on the existing pattern. At the same time, machinery products cannot be sold at unduly high prices, in comparison with international prices, after excluding cases of 'dumping', as this could have an important bearing on the pricing of products manufactured by such machines. A limit which has been informally operative in Mexico in some cases is a differential of 25% over imported prices. A 25-30% differential is reasonable, if limited to a period of 5 years, after which the differential could be reduced to 20% for a further period of 10 years & be reviewed thereafter. It is essential, however, that such a differential should be clearly defined & should, equally unequivocally, be acted upon. The practice in Mexico has been relatively flexible in this regard &, while this has its advantages, it would be more desirable in the interests of sectoral growth to prescribe a definitive policy, so that there is full awareness on the part of both manufacturers & consumers. Apart from a definitive price differential, it is even more important that considerations of delivery & specifications are not utilised to bypass domestic manufacturers. It is understood to be relatively common for major purchasers, particularly in the public sector, to insist on imports on the ground that domestic delivery is not suitable. The speedy delivery required is often as not due to lack of planning on the part of the purchaser. Where such lack of planning is deliberate, the case becomes all the more reprehensible. The manufacturing cycle for heavy machinery products can extend to 2-3 years & unless orders are placed on the manufacturing enterprises in good time, there would obviously be delivery constraints. A degree of reconciliation

is sought to be effected through the Import Committee set up for public-sector imports, but it is difficult to accept that the very large imports of relatively simple machinery products that occurred during 1970-74 could not have been substantially reduced if equipment orders had been placed well in time. In some countries, where there is considerable centralised planning, running orders for heavy equipment are placed on certain major machine-building enterprises, so that there is a better order-book & capacity utilisation on the one hand & more effective purchase planning on the other. Machine-building units in Mexico, however, tend to suffer from a 'glut' of orders for some periods as at present & a relatively lean order-book during other periods. This needs to be avoided to the extent practicable & this can best be achieved by a greater degree of relatively longer-term planning on the part of the major machinery purchasers. The Import Committee should, in such cases, insist on a co-ordinated purchase programme spread over at least a 3-year period. In some cases, this may be restricted by budgetary uncertainties, but unless the manufacturing cycle period is covered, the situation cannot be satisfactorily resolved. What is true of public-sector imports is applicable to private-sector imports, though to a much lesser extent, as the border closure applies to such units to a much greater extent. In the matter of specifications, there is less room for conflict, though here too there have been instances where fairly narrow specifications have ruled out purchases from domestic enterprises. While purchasing enterprises & institutions are naturally desirous to avail of the latest technological innovations or imported products to which they have been used for long periods, this needs to be reconciled with the possibilities of domestic manufacture as far as possible.

54. An equally important issue is the choice of technology & make for a particular machinery product and the degree of association considered necessary on the part of the principal consumers with such a decision. Purchasers, particularly monopoly or bulk purchasers, would naturally prefer to be unfettered in their choice & would seek to avoid any purchase commitment for a particular make. On the other hand, potential manufacturers find it difficult to make investment decisions in the absence of at least a general acceptance of a particular machinery model or make on the part of a major consumer or consumers, & would of course prefer a long-term commitment. Even a broad acceptance has sometimes been difficult to obtain. The domestic manufacture of industrial steam turbines has, for example, been complicated by the fact that a major institutional consumer was not willing to even consider a general acceptance for 3 different international makes, while the manufacturer of a possibly-acceptable make, was not interested in a project in Mexico. A major order by the public-sector sugar industry was, at the same time, placed on a foreign manufacturer with little or no links with a domestic production programme. While it would be unreasonable for potential investors to



expect any purchase commitment from major or bulk consumers, any investment negotiation becomes unrealistic if there is not even a general understanding from the principal institutional consumer or consumers that the products of such an enterprise would be acceptable to the consumer or consumers, subject to satisfactory quality & to considerations of price & delivery in accordance with an agreed policy framework. If a monopoly or bulk consumer does not accept even such a broad condition in respect of a machinery product accepted internationally, it is necessary for the government to intervene & insist on such a provision. This essential co-ordination role has been sought to be discharged by NAFINSA for some of the projects under consideration. This has resulted in difficulty & delay in some cases. In countries where there is a system of industrial licensing, the decision as to technology & make is invariably taken by the government & this is then binding on all domestic consumers. In Mexico, a suitable mechanism needs to be evolved, so that decisions as to technology, model & make can be taken, which are consistent both with the interests of major domestic consumers, as also with the availability of suitable technology & the evolving of an appropriate pattern of investment in each case.

Plant capacity  
& investment  
pattern:

55. The size & capacity of machine-building enterprises has necessarily to be related to the size of the potential market, initially domestic gradually extending to exports. As pointed out in para 5.9, however, most machine-building plants tend to have a composite product mix & capacity is often determined in terms of total tonnage or output value during a particular period. Scale economies nevertheless do enter the picture, both in respect of machinery products having relatively long production runs such as diesel engine castings or small motors or transformers, as also for large engineering & fabrication workshops where capacity is related to effective utilisation of machine centres or groups or even of particular complex & sophisticated machines. It is difficult to generalise in respect of appropriate plant capacities in machine-building. Problems of management & control can become very difficult in a major single complex manufacturing, for example, a wide range of electrical equipment. The same would be true for mechanical equipment such as machine tools, though there are a number of instances such as Hindustan Machine Tools in India & large complexes in Czechoslovakia & Yugoslavia, where a wide range of machine tools of varying complexity are manufactured in single enterprises. The pattern in Europe & in the USA has been for relatively middle-sized enterprises specialising in particular machinery products, not only in the machine-tool field but for mechanical equipment in general. Major machine-building complexes, which developed over a period of time, have tended to gradually siphon off specific production lines to subsidiary enterprises, so that each production unit becomes highly specialised in relation to a particular product or group of products. At the same time, there has been an equally marked tendency in industrialised countries towards mergers. In some countries like the U.K.,

*this has been related to allied production sectors but in the USA, the growth of conglomerates has been equally pronounced.*

*56. In the Capital-Goods Project, the consideration of capacity has been viewed in a flexible & pragmatic manner. Though, for example, it has been recommended that a major new plant should be set up for transformer production with an investment of our Ps 250 million, it would not be inappropriate to split this investment requirement between two projects, one of which would be for expansion of an existing facility, as is being negotiated. There would be greater difficulty in splitting the investment in certain other projects, such as for steel plant equipment or heavy mechanical equipment such as hydro-turbines or rotary kilns for the cement industry or complex process equipment for the chemical industry, where a minimum machine complex would be necessary involving large capital outlay.*

*57. It has been a general recommendation of the Capital-goods Project that reputed foreign technology should be acquired for the various projects & that there should be a degree of capital participation by the technology supplier. This is in the interest of securing full & complete technological participation on a long-term basis. A pattern of investment involving 33-40% capital participation by the technology supplier, while the balance would be Mexican capital, including NAFINSA shareholding, had been earlier considered as an appropriate pattern. This may not always be practicable to implement. In some cases, as in electric motors & centrifugal compressors, the potential foreign partner has insisted on 49%. This is ofcourse fully within the prescribed law & policies of the country in respect of foreign investment. A problem tends to develop in respect of the 51% shareholding. If a Mexican enterprise is to be a partner, it would prefer an equity holding at least equal to the foreign partner. If NAFINSA is to be the majority partner, the responsibilities of a majority holding would devolve on this body. Experience of the various projects under negotiation suggest that while a tripartite partnership between NAFINSA, a suitable Mexican enterprise & a foreign partner is desirable & may be able to be evolved in some cases, it would be necessary in other instances to consider either bilateral joint ventures between NAFINSA and foreign parties, or projects by Mexican entrepreneurial groups with NAFINSA financial support & participation & with foreign licensing arrangements. A fourth alternative which may also have to be considered is the establishment of one or more heavy-machinery complexes in the Mexican public sector, with NAFINSA financing & foreign technology licensing. With the wide range of projects under consideration in the capital-goods sector, no single investment pattern can be prescribed which would be applicable in all cases.*

58. Whatever investment patterns emerge for the various projects under consideration & negotiation at present, there can be little doubt that the role of NAFINSA would necessarily have to be very significant, not only as a promotional agency but as an active participant in a number of fairly complex projects. The role of the NAFINSA counterpart groups will need to be considerably enlarged in the above context. At present, the UNIDO-NAFIN Group has been principally concerned with initial negotiations upto the stage that formal investment propositions can be identified in fairly detailed terms. Thereafter, final negotiations are intended to be conducted by one or other branch of NAFINSA. It may be more desirable to set up a fairly large unit in NAFINSA, which would deal with the various investment propositions from the initial upto the final stages of negotiation & investment decision. The NAFINSA counterpart group is a nucleus, which can be suitably expanded to cover this role as this group has been associated with most of the projects from the earliest stages. However, this is an organisational aspect for NAFINSA to consider.

59. A related but essential organisational aspect is the building up of an unit in NAFINSA, which can handle technology & contractual negotiations for the establishment of machine-building projects. This has been a task with which the UNIDO Project Manager has been fairly closely associated in the initial stages & negotiations of a number of projects. It is, however, necessary to build up further expertise in this branch of the negotiations. For this purpose, it would be desirable for the NAFINSA unit to work in close collaboration with the Registry of Transfer of Technology in the Ministry of Industry & Commerce, so that there is full awareness & exchange of views regarding various contractual provisions & the appropriateness or otherwise of particular technology fees & royalties in various machine-building projects.

financing of  
capital-goods  
production of  
plants

60. A basic policy aspect of capital-goods production in Mexico relates to the financing of specific investment propositions for machinery manufacture, as also the financing of sales of capital goods produced in the country. \* The high cost of borrowing in Mexico, with interest rates normally ranging from 15% upwards constitutes a significant constraint on resource channelisation into industrial sectors where returns tend to be low during initial production years while capital outlay is relatively high. It is necessary that the problem of financing of such projects is tackled

\* A note on the subject entitled "Creation of a Special Fund for Financing Capital-Goods Production in Mexico" was submitted by the UNIDO Project Manager to NAFINSA earlier (July 1975).

on a special footing. As mentioned in other previous chapter, the projected investment requirements for the various machinery sub-sectors & projects under consideration is of the order of Ps. 3000 million during 1976-78. This is on the assumption that policy & investment decisions will be taken during 1976 for all or most of the projects outlined in the previous chapters.

61. Against a total capital investment (excluding working capital) programme of Ps 3000 million in 1976-78, the equity capital needs would be of the order of Ps 1,500 million assuming a debt-equity ratio of 1.1. Of this amount, about Ps 900 million would need to be raised from national sources, including NAFINSA, while the balance of Ps 600 million can be expected to be contributed by foreign equity participation, on the assumption of an average participation of around 38-40% by the foreign partners. As for the debt-equity ratio, this would vary for different projects but a 1:1 relationship would be fairly reasonable for machinery-manufacturing projects, as this is commonly accepted in many countries for estimation purposes in the capital-goods sector. It is recognised that, in Mexico, a greater proportion of capital investment is usually sought to be covered by equity capital in view of high interest charges on loans but it would be desirable for most capital-goods projects, many of which involve large capital outlay, to be programmed and evaluated on the basis of 40-50% of the fixed-assets being financed by medium or long-term credit. The ratio of 1:1 need not necessarily be applied to the various projects but could adequately serve as a yardstick for overall estimates and valuation. On this proportion, the requirements of medium-term financing could well be of the order of Ps 1,500 million. It may be possible to obtain machinery and equipment for many of the capital-goods projects on satisfactory foreign supplier-credit terms without affecting the cost-structure of such projects adversely. Assuming that such supplier-credit may cover 33% of the requirement, this would leave a gap of about Ps 1,000 million to be covered from national credit institutions. This would be apart from working capital needs, which would also have to be obtained from domestic banking sources.

62. Apart from credit financing of fixed investment, an equally urgent need is in respect of credit financing for purchasers of domestically-manufactured machinery. An important incentive for machinery imports on the part of domestic enterprises is the fact of supplier credit accompanying such imports and the consequently reduced initial equity capital. If sales of domestically-produced equipment are to be actively encouraged and promoted, some financing arrangement similar to foreign supplier-credit would constitute a significant incentive. This aspect would assume increased importance from 1978-9 onwards by when production is likely to commence in many of the capital-goods projects currently under consideration.

63. It is necessary to consider the various sources and nature of institutional credit that would be available for this purpose in Mexico. Apart from the general banking sector, the three specialised institutions dealing with industrial financing are FOGAIN,\* FOMIN,\*\* and FONEI.\*\*\* As for the banking sector, the operative interest rate would normally range from 14% to 17%, and there is no significant interest differential as between working capital and medium-term loans. Such an interest structure would impose an unduly heavy burden for capital-goods projects, particularly in respect of financing of fixed assets. The role of FOGAIN is principally confined to the small-scale sector and though FOGAIN's interest rate ranges from 10% in Zone III to 12% in Zone I, its credit activities are confined to projects involving investment of less than Ps 25 million. In the case of FOMIN, the role is principally that of equity participation which can be contributed upto 33% in small and medium projects. This institution has participated in the establishment of 46 new industries and expansion of 49 other units. The total financial commitments of FOMIN extend upto Ps 185 million. Apart from FOMIN's funds being very limited, it is not functioning significantly as a credit agency and while its equity participation role may assist in the promotion of some capital-goods projects, it cannot be viewed as a significant credit-finance agency for this sector. As for FONEI, which was set in 1972 principally for financing machinery purchase by export-oriented or import substitution enterprises, this could serve the purpose to a certain extent. There are, however, certain limitations to this institution also serving as the principal credit agency. Firstly, the existing resources of the institution would be considerably stretched if it were required to meet an overall funding requirement of this magnitude. Secondly, the fund is primarily intended to finance machinery purchases. Since this can be often obtained from foreign supplier credit for a number of capital-goods projects, the utilisation of FONEI can become fairly limited. Thirdly, the Fund operates through the normal banking structure, which means an addition of 2 to 3% in the interest rate as far as the borrowing enterprise is concerned. Fourthly, FONEI does not lend itself to serving as a credit institution financing domestic sales of individual machinery products. With the limited growth of the domestic capital-goods sector, the machinery financing facility relates principally to imported machinery. Despite these aspects, FONEI can serve as an useful financing source for some of the capital-goods projects. The institution can grant intermediate and long-term loans upto a maximum of 13 years (with a grace period of 3 years) and at an interest of 10% to the banks which, in turn loan to enterprises at 12-13%. The institution has financed 42 loans to different enterprises by June 1975 besides 6 loans for feasibility studies and its activities could usefully extend to financing some of the proposed machine-building units.

\* Fondo de Garantía y Fomento a la Industria Mediana y Pequeña (FOGAIN)

\*\* Fondo Nacional de Fomento Industrial (FOMIN)

\*\*\* Fondo Nacional de Equipamiento Industrial (FONEI)

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64. It needs to be considered, in the above context, whether the financing requirements of the capital-goods sector should be met by one or other of the existing Funds, together with the overall banking system or whether a new Fund should be set up, principally for the capital-goods sector. It appears that, while existing institutions such as FOMIN, or more particularly FONEI, have certain resources which could be utilised for participation in some of the projects under consideration, these institutions would fall short, both in terms of overall resources and functions, in meeting the requirements of this sector. An alternative which needs to be considered is the establishment of a new Fund, principally for the machine-building sector which would be broader in its functional scope and adequately flexible in operations to meet the needs of this sector. The scope would be much broader in that a new Capital-Goods Fund could (a) finance new or expansion capital-goods projects, both by way of equity participation and medium-term loans to cover initial capital investment, (b) provide credit to cover not only machinery but could relate to overall fixed capital, (c) guarantee repayment of supplier credits obtained by projects, (d) provide credit at more favourable terms than from other credit and banking institutions in the country, (e) provide credit (similar to supplier credit) to enterprises producing domestically-manufactured equipment, both in respect of overall plant and equipment for a new or expansion project (as financed by FONEI) but also for individual machinery products on internationally-competitive terms and (f) assist, through its participation and credit programmes, the co-ordinated establishment and growth of different projects in this sector.

65. The most critical question revolves around the interest rate of be charged on loans to capital-goods enterprises. It is essential that such interest should be substantially below the prevalent interest rates in Mexico. This is necessary because a lower interest rate would (i) attract domestic investible resources to capital goods manufacture as this would be direct incentive for such investments, (ii) reduce the impact of longer gestation periods and lower initial earnings in this sector, (iii) reduce the excessive burden that would be otherwise imposed on new and expansion projects, (iv) provide loan capital at rates which would be similar to those obtained by capital-goods enterprises in other countries and (v) in general, enable capital-goods enterprises to become viable and internationally-competitive. Unless a differential rate of interest is provided for this sector, there would be a tendency for capital-goods enterprises to avail of medium-term credit only to the minimum extent, thereby either reducing the overall magnitude of projects or providing an unnecessarily high equity capital base.

66. The fact that capital-goods enterprises would require credit at differential rates would be an added ground for channellisation of funds for this sector through a new Fund as it would be difficult for existing

institutions to charge differential rates for different industrial sectors. Charging of a lower interest rate would also inevitably involve a major element of subsidy which could only be provided by the State. Assuming that financing for such a Fund is obtained from external loan sources, it would be desirable to subsidise the loans issued by the Fund to the extent of 1% plus the cost of administration which could be assumed at a further 1%. In such event, the subsidy would be 2% and this would enable medium-term loans to capital-goods enterprises to be issued at 1% below international rates. This should constitute a significant incentive for the rapid growth of this sector. For purposes of initial estimation, the prime Eurodollar rate may be adopted as a base. This had come down from 13% in June 74 to about 8-9%. The trend of falling interest rates is common in many countries at present. In Mexico, the rate continues to be much higher, as before. It is not practicable to suggest any specific interest rate as this would have to be related to overall credit conditions in the international and national sectors, but provision of 2% subsidy on the rate at which loans are secured by the institutional agency would mean that capital-goods enterprises could obtain medium-term credit at a favourable rate as compared to international interest rates and on substantially better terms than can be secured internally by other domestic enterprises. The difference between the latter enterprises and capital-goods projects could range to 3-4% depending on the gap between national interest rates and those prevailing in the Eurodollar or U.S. markets at particular point of time. A difference of this order would act as a major incentive to attract resources and private sector investment to this sector apart from making machinery projects in Mexico adequately viable and competitive. The magnitude of subsidy would depend on the extent to which the resources of the Fund are channelised as loans. Assuming that the Fund would have resources of Ps 1,000 million & that, of this, 50% or Ps 500 million is channelised as medium-term loans, the subsidy would be of the order of Ps 10 million per year. This would not be considered as too heavy a burden for the state for the development of a critical & dynamic sector which could bring about substantial improvement in the merchandise balance of payments.

67. It is accordingly recommended that a new Fund be set up, in Nacional Financiera, for financing the establishment of capital-goods industries. For the purpose of this Fund, which may be called Fondo para Desarrollo de Industria de Bienes de Capital (FODIBIC), Capital-Goods industries may be defined as the manufacture of all mechanical (non-electrical) and electrical equipment & major parts & components thereof, utilised as machinery & production equipment in various production branches. This definition would cover the transformer equipment sector also. The Fund should be set up with initial resources of Ps 1,000 million, to be increased to Ps 2,000 million in 1978. The initial resources could be raised by Nacional Financiera from external sources

through bond issue at prevalent market rates.

68. The objectives of FODIBIC would be to (a) financially assist in the establishment or expansion of enterprises in Mexico undertaking the manufacture of capital-goods products, as defined above, such financing taking the form of medium-term loans at a subsidised rate or equity participation or both and including guaranteeing of term loans secured externally by such enterprises, (b) encourage and promote the development of internal and external private and public capital availability in the programming and financing of capital-goods manufacturing projects and (c) financially assist the marketing and sale, both internally and outside the country, of machinery products produced by such enterprises. To achieve these objectives, FODIBIC could (i) provide finance in the form of loans extending over 5 to 15 years and at suitable interest rates approved from time to time for new and expansion projects manufacturing capital-goods items, (ii) participate in the equity capital of such enterprises to the extent of 20% to 51% (iii) make funds available for re-investments and by causing the transfer of shares and securities (iv) furnish managerial technological and administrative advice as may be required and assist with technical and other services (v) sponsor and/or underwrite any issue or conversion of all forms of shares and securities (vi) guarantee and counter-guarantee loans and obligations of such enterprises and (vii) finance the marketing and sale of machinery and allied products of such enterprises through credits to purchasers of such products.

69. It must be emphasised that FODIBIC's activities should not normally extend to supply of working capital for capital-goods enterprises. For this purpose, the enterprises should take recourse to the normal banking sector. This is partly because working capital would involve very substantial increase in the Fund's commitments and extend the Fund's activity to a function that could be covered adequately by the banking sector. At the same time, the incidence of interest liabilities on short-term working capital loans would be relatively smaller and should be able to be absorbed in production costing without affecting the units too adversely.

70. As discussed earlier, an important function of the proposed new Fund would be to finance sales of indigenously-produced machinery items. As far as exports of such items are concerned, this function would also be performed by the Export Development Fund (FOMEX), as at present. FOMEX's role, however, extends to all exports and the facilities provided by this institution may not be adequate for machinery products in a number of cases. FODIBIC's activities could be complementary in this regard and it could provide such special facilities as machinery products may require so as to compete effectively in international markets. Capital-goods exports are often afforded very special concessions besides long-



term supplier credit by a number of countries and these can extend to direct export subsidies of upto 15-20%. If Mexican capital-goods exports are to compete in international markets speedily, major concessions and incentives may be required in the early years and this could be provided by the new Fund in addition to or in substitution of the facilities provided by FOMEX to this sector. As far as internal sales are concerned, FODIBIC's activities would be even more significant. Both public and private-sector enterprises tend to use supplier credits for machinery purchases because of the long or medium term credit element involved. It is necessary that domestic manufacturers should have the same or similar facilities, both for bulk purchase of capital equipment and for purchase of specific machines produced in the country. The credit terms in such cases could extend to 5-7 years at a subsidised and competitive interest rate for bulk purchase of original plant equipment domestically produced. As for individual machines such as machine tools, compressors etc., the proposed new Fund could also consider hire-purchase provisions at a reasonable interest. This would both enable small-scale industries to buy such machines and equipment without much initial capital outlay and would also give a significant jillip to internal sales of such machines.

71. Apart from financing facilities, both for resource mobilisation for machinery production & sales, a comprehensive policy package needs to be considered for the capital-goods sector within the overall economic policy framework of the country. As in the case of export-oriented enterprises, the needs of machine-building industries can be considered on a special footing which can, at the same time, be fully consistent with the country's economic & industrial policies. This can be done by declaring the capital-goods sector as a 'priority' sector within the framework of the present law for 'new & necessary' industries. Such a definition should bring, in its wake, certain facilities & incentives as a matter of course. Some of such facilities are discussed hereinafter in respect of protection measures, provision of basic imports at reasonable cost, & financial & tax incentives.

#### Protection & controls

72. Measures of import control have been tightened considerably over the last year. Such tightening has been activated more by the deterioration in the merchandise balance of payments than by the need for protecting domestic industry. It is too early to determine the impact of the latest policy of controls on capital-goods imports but it is doubtful whether such impact would be highly significant. The import projections made in Chapter III are unlikely to be substantially curtailed, as the genuine & legitimate needs of machinery & components in the different production sectors have necessarily to be met. In fact, quantitative import controls & 'closing the border' may not prove to be the long-term answer for such sectoral growth. Machine-building enterprises do require a sheltered market but for as minimum a period as possible. It is considered that a

period of 3 years from commencement of production should be adequate. This would, on the one hand, ensure that the 'teething' period of such enterprises can be overcome & domestic machinery products can find a ready internal market & on the other hand, would enable importation to the extent of the obvious shortfall between production by domestic enterprises & the overall demand of the economy for the products in question. The infant industry argument is equally, or even more applicable, in the capital-goods sector but this must be for a very limited period of time so that inefficiencies do not creep in or become inherent in such enterprises.

73. What is of greater importance perhaps is a more selective policy of import tariffs. Till recently, machinery imports enjoyed a concessional tariff which amounted to 8% (Rule XIV) as against 20% for most comparable products, while further relief was available in certain categories of industries & for certain locations. While the concession under Rule XIV has been done away with, other reliefs can still be obtained. It would be desirable to remove all tariff concessions on imports of finished machines, irrespective of the industrial sector or the location. Machinery & equipment should be brought fully in line with other industrial products & should in the initial instance pay a tariff of 25 to 30%. If financial concessions are to be given for encouragement of particular industrial sectors or growth of particular regions, this could take the form of a direct subsidy or higher tax concession but should not be related to cost of imported machinery & equipment. Again, for export-oriented industry, financial relief could take other forms of direct benefits rather than concessions on machinery imports. The higher cost of machinery & equipment needs to be absorbed in the economy, not only as an indirect incentive to domestic production but to reduce the government's loss of income from this concession. The production sector needs to move to a import-tariff economy and away from an import-control economy, particularly in so far as machinery imports are concerned. It must also be recognised that the direct impact of a 25-30% tariff on machinery imports by all machinery consumers both in the public & private sectors, is likely to be far greater than an import-control policy which tends to be much easier to bypass.

74. As observed earlier, the import tariff on machinery & equipment should be initially higher (25-30%) for a period of around 5 years in selected branches & should thereafter be brought down to around 20% for a 10-year period, after which this could be reviewed. Most capital-goods enterprises should be able to compete effectively with imported products within a period of 5-7 years, provided internal demand grows adequately & provided that input costs do not continue to be substantially higher. A policy combining import controls for upto 3 years in cases where domestic machinery production is undertaken, with an initial domestic tariff of 25-30% for 5 years & with financing of domestic sales through the proposal

**FODIBIC would provide a sound initial policy base.**

**Provision of inputs & domestic integration:**

75. **Production efficiency & costs in machinery manufacture are directly related, in a large number of cases, to costs of basic inputs. The cost of bought-out components & items tends to be much higher in Mexico despite the fact that basic industrial materials are generally available at around competitive prices. The insistence on high domestic integration in Mexico, in common with most developing countries in a similar stage of development, is a valid & understandable policy approach but tends to aggravate the situation in so far as input costs are concerned. The general tendency is for input production to follow production of the finished equipment & there is usually a time-lag, which can extend over years at a time & which may get increasingly accentuated if a comprehensive production programme is undertaken for machinery production, without adequate care being taken regarding basic inputs. It is for this reason that emphasis has been given to the need for production of heavy & medium castings, gears & speed-changers & the like. Input items, however, cover a very wide range & an important future exercise would be to define the specific inputs for the various projects that are being developed & to ensure that production gaps in this regard are minimised as far as possible.**

76. **It is necessary, however, that if machinery products are to reach competitive efficiency, inputs in the form of materials & components must be available at reasonable cost. It is not suggested that the emphasis on domestic integration is reduced. Such a policy can, however, be quite consistent with a more liberal & flexible policy in so far as imports of unduly high-priced domestic inputs are concerned. It is suggested that, in cases where the machine-building enterprise is unable to obtain basic inputs internally within a 25% price differential, the import of such inputs should be permitted under 'Actual User' licenses. This implies that importing enterprises must certify both as to the requirement & utilisation of inputs in accordance with their production programme for a particular period of 3 to 6 months. Such user imports would constitute a strong incentive for input manufacturers to bring their prices more in line, through greater production or efficiency. Just as domestic manufacturers can represent before the relevant Import Committee against a proposed import, so also can input manufacturers & suppliers against imports of such supplies but if domestic prices are higher than the 25% differential suggested, it is necessary that imports should be allowed for defined periods, so that the matter can be reviewed from time to time. The above import policy would not materially effect the domestic integration, which should continue as at present but with this significant qualification.**

77. A related question is that of tariffs on parts & components. Under the present system, import tariffs on components & inputs are often higher than on the finished machine. This aspect needs to be reviewed. The tariff on inputs should not be higher, in any case, than the tariff on the finished equipment. Against an initial tariff of 25-30% on machinery & equipment, the tariff on components, parts & accessories of such equipment should be of the order of 15%. This tariff can then be taken into account in determining the cost of the imported input, as against the same item domestically produced.

Incentives:

78. The present system of the incentives is largely based on the Decentralisation Decree of 1972 & its subsequent modifications, though some of the general provisions under the Law for the Development of New & Necessary Industries still remain applicable. While the present system is far more definitive than before, in so far as the prescription of concessions & incentives is concerned, it is still difficult sometimes for potential entrepreneurs to calculate the direct benefits that would accrue. It is clearly advantageous of course for new & even major expansion projects to seek locations in Zone III & to avoid the industrial concentration of Mexico City, Monterrey & Guadalajara. From a locational viewpoint, the advantages are fairly unambiguous and emphasis has been given in the various projects under negotiation & consideration that plant locations should invariably be in Zone III. From a sectoral viewpoint, however, the tax concessions offered are relatively non-selective. It may be considered, for example, whether the period of accumulated losses to be set off against tax dues could be extended in the case of machine-building industries, defining these as a priority sector as mentioned earlier. Accelerated depreciation provisions could be adopted as a normal course. A policy of 'development rebate' has been usefully utilised in certain developing countries to channelise resources into priority sectors & this could also usefully be considered in Mexico. This provides for a special deduction by way of a rebate at a specific percentage (ranging from 15 to 40%) of the cost of new-plant or machinery which is allowed against profits. Such a facility, if extended to the capital-goods sector as a priority sector, would constitute a significant advantage, when viewed in conjunction with depreciation allowance.

79. Specific mention needs to be made of an important tax concession which has recently been removed, to the considerable disadvantage of capital-goods enterprises. Till 1974, such enterprises were able to extend the system of tax cedis (certificados de devolución de impuestos indirectos) permitted for exports to import-substitution products also. It is understood that this is not permitted any longer. Most machine-building production constitutes direct import substitution & it seems only

*appropriate that capital-goods enterprises at least should be extended this facility, if necessary for a defined period of time of 3 to 5 years.*

Training subsidy:

80. *As pointed out in earlier chapters, considerable emphasis has been given to the question of adequate training of various categories of workers for machine-building enterprises. The cost of such training, however, is a heavy burden on such enterprises, particular in the early stages. It is suggested that the government considers the grant of a suitable subsidy for training of workers on new machine-building plants or cases of substantial expansion. This can be done on a percapita basis & linked to a period of training for each category of unskilled and semiskilled workers.*

81. *Financial incentives in the form of tax refund certificates (cedis) is provided for exports. The operative rate ranges between 9-11% though some additional relief is available if exports are channelised through a consortium or an export service firm & exports are raised by a minimum level. Institutional export finance is provided through the Export Development Fund (FOMEX) while the Compañía Mexicana de Seguros de Crédito (COMESSEC) provides guarantees against export risks. In so far as the machine-building sector is concerned, it is considered that the measures adopted may not be adequate for developing a significant export bias in this sector. A number of valuable suggestions relating to the system of export subsidies have been made in another UNIDO study \* which need to be considered once again. A suggestion which is of particular relevance to the development of export capability of machinery enterprises is that duty-free imports of inputs should be permitted to the extent of imports. Such a system of 'bonus vouchers,' which was also recommended in the Phase IB Report by the undersigned, would constitute a very significant incentive for such enterprises to develop exports. Such 'bonus vouchers' should be over & above the import of inputs not domestically produced or whose import is permitted because of unduly-high domestic prices.*

82. *The actual quantum of export cedis should be increased to 20% in the case of capital-goods exports, while the present level of cedis should be retained for relief on account of import substitution in so far as the capital-goods sector is concerned. The calculation of cedis should also include not only direct labour costs but also direct costs of engineering by the Mexican Company.*

\* Bela Balassa & Line "Industrial Protection in Mexico". UNIDO/TCD 310 - May 1974. Unpublished.

Investment promotion:

83. Despite the various concessions & incentives briefly discussed above, an aggressive investment promotion effort is necessary if really significant growth in the capital-goods sector is to be achieved. This is sometimes not fully appreciated. The Capital-goods Project succeeded in initiating a number of possible investment propositions only because the investment promotion & programming activities proceeded simultaneously with the various techno-economic studies. In instances where an alternative approach was adopted, the proposals & possibilities tended to get delayed. The projects under present consideration, however, also require constant follow-up. Since a number of projects are involved, this is not always easy & there may be a tendency to concentrate on certain projects & sectors at the cost of others. Such a tendency needs to be avoided if balanced growth of the sector is to be achieved. Potential investors in major machine-building enterprises often need considerable prodding & encouragement. It is undoubtedly easier, & perhaps more dignified, for investment institutions to wait for specific investment propositions & to react to these appropriately; however, in the promotion of capital-goods production, such a period of waiting may get unduly prolonged. It is also necessary to recognise & accept that the most suitable entrepreneurial group or technology owners may not be interested in a particular project or even in a particular country for a variety of reasons. In such cases, it is necessary to accept such technology & such investment pattern as is forthcoming, with full recognition of the limitations that this may involve.

84. A number of qualitative aspects of machinery manufacture have not been tackled by the Capital-Goods Project so far. These include questions such as standardisation & quality control. It is hoped that these aspects will be given greater attention in the remaining period of this Project.

Co-ordination

85. It will be seen from the above that accelerated growth of the capital-goods sector requires positive & deliberative efforts in a number of directions. It is not enough to prepare market studies & await sectoral growth as a logical consequence. For greater efforts are called for, particularly towards creating a suitable climate for such growth. It is not only necessary to have an active investment promotion programme coupled with a dynamic policy package, but these two basic pre-requisites have to be combined with a high degree of co-ordination between concerned agencies & institutions of government. As the country's premier institution in the field of industrial development banking, Nacional Financiera is in an unique position to perform the role of co-ordination & to serve as a vital

***catalytic agent for the effective growth of this key & basic manufacturing sector. It is hoped that the efforts made & generated through the Capital Goods Development Project over the last few years will be of some use & assistance to this institution in discharging this vital function.***

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Annex

LIST OF PROJECT PERSONNEL

UNDP/UNIDO experts

During the period from September 1973 to March 1976 the following international UNDP/UNIDO experts worked on the project in the posts shown:

Rana K. D. N. Singh (India)	Project Manager and policy adviser	Mar. 1972 - Mar. 1976
H. R. Hargreaves (United Kingdom)	Project planner	Apr. 1974 - July 1975
Per Blondell (Sweden)	Project evaluator	Nov. 1973 - Mar. 1975
Richard Kitchen (United Kingdom)	Project evaluator	July 1975 - Oct. 1975
S. Bjorkenstan (Sweden)	Expert, diesel engines	Oct. 1974 - Dec. 1974
R. Longley (United Kingdom)	Expert, machine tools	Apr. 1974 - Dec. 1975 Sept. 1975 - Feb. 1976
C. Weekhout (Netherlands)	Expert, pumps and compressors	Aug. 1974 - Jan. 1975
J. Shand (United Kingdom)	Expert, foundries	Feb. 1974 - Dec. 1974
C. Back (Sweden)	Expert, gears and forgings	Oct. 1974 - Mar. 1975
K. Oehler (Federal Republic of Germany)	Expert, power boilers	July 1974 - Sept. 1974
T. Weidmann (Austria)	Expert, insulators	Nov. 1974 - Feb. 1975
S. Sanyambu (India)	Expert, transformers and circuit breakers Electric motors and generators	Mar. 1974 - Sept. 1974 Oct. 1974 - Mar. 1975
J. Zdenek (Czechoslovakia)	Domestic market analyst	Oct. 1975 - Feb. 1976
O. Joklik	Expert, chemical equipment	Oct. 1975 - Jan. 1976
C. L. Sengupta	Expert, steel plant equipment	June 1975 - May 1976
J. Schirm (Federal Republic of Germany)	Expert, hydro turbines	Oct. 1975 - Jan. 1976



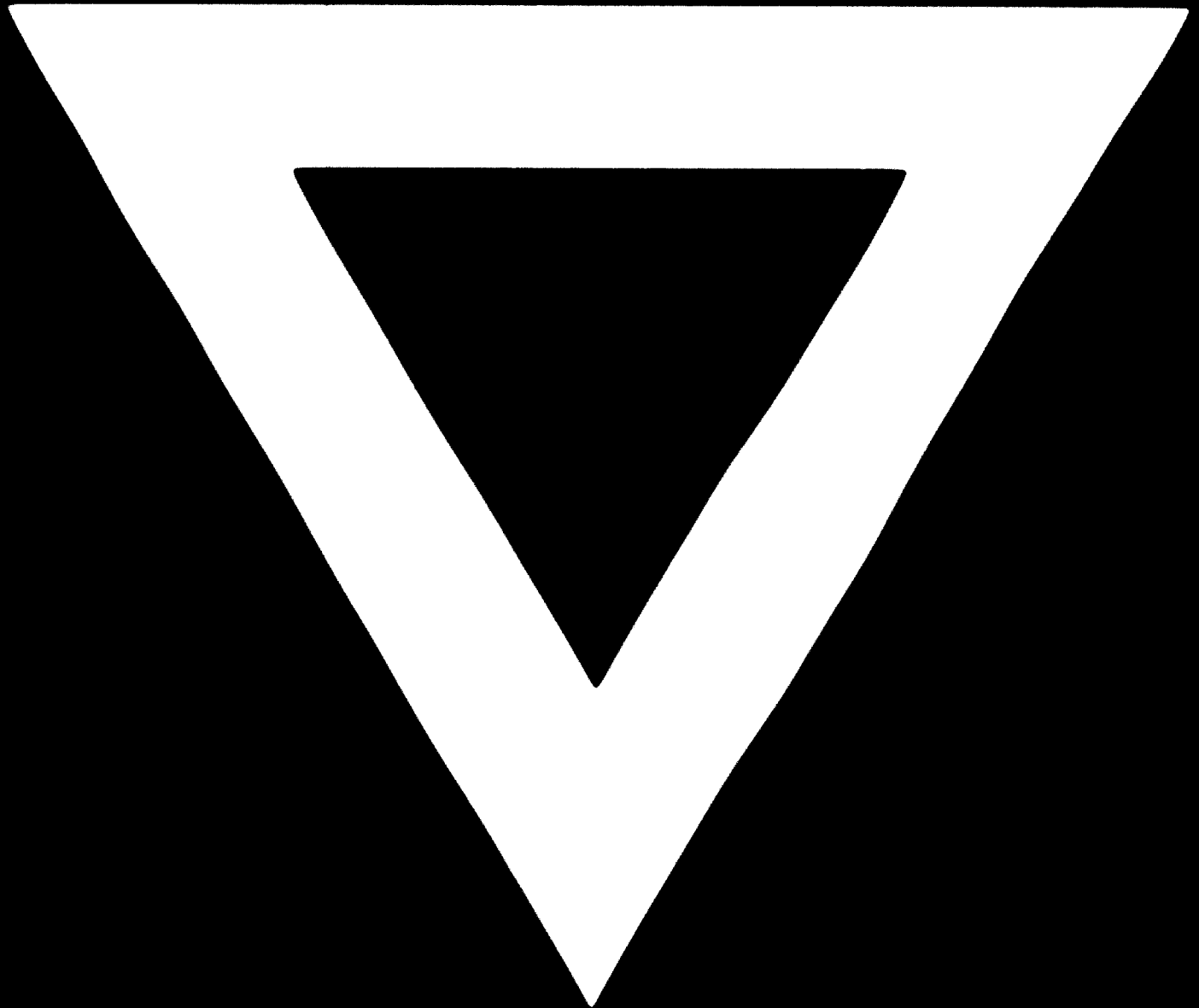
Counterparts

The international experts recruited by UNIDO worked in close collaboration with the counterpart staff of Nacional Financiera who were appointed to work full-time on the project.

S. Vélaz	Chief, NAFIN group	July 1974 - continuing
H. Castro	Chief, NAFIN group	Sept. 1973 - July 1974
C. Morton	Economist	June 1974 - continuing
B. Fonseca	Electrical engineer	Sept. 1974 - continuing
R. López Arce	Mechanical engineer	Mar. 1973 - continuing
S. Mesa	Electrical engineer	Aug. 1973 - continuing
G. Deschamps	Electrical engineer	Sept. 1974 - continuing
R. Haro	Economist	June 1974 - continuing
C. Cuerrero	Mechanical engineer	Feb. 1975 - continuing
J. A. Velazquez	Mechanical/electrical engineer	Oct. 1973 - continuing
R. Vega	Economist	Jan. 1974 - continuing
R. Hernández	PEMEX, engineer	Apr. 1973 - Dec. 1975



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