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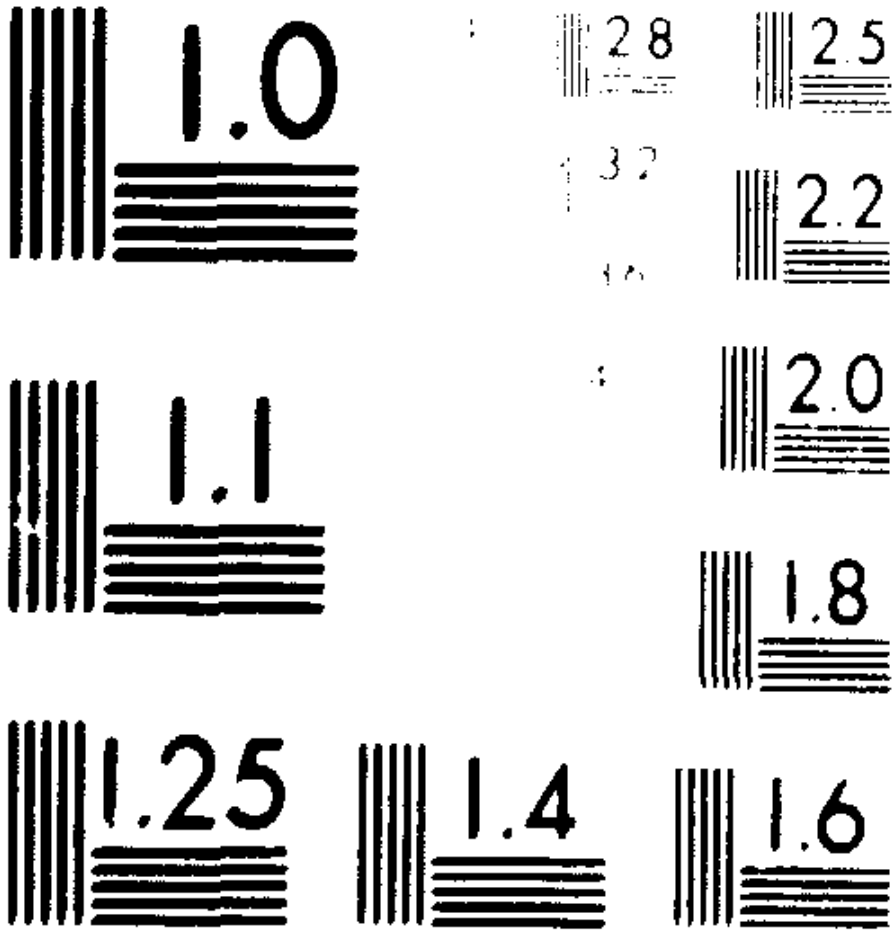
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TURKEY AS A CASE STUDY OF A DEVELOPING COUNTRY IN THE DEVELOPMENT OF PETROCHEMICAL INDUSTRY

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1982
ANKARA

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TURKEY AS A CASE STUDY OF A DEVELOPING COUNTRY IN THE DEVELOPMENT OF PETROCHEMICAL INDUSTRY

1. Introduction

1.1 The purpose of the study

The second Consultation on the Petrochemical Industry was held in ISTANBUL from 22 to 26 June, 1981. According to the Conclusions and Recommendations obtained UNIDO should prepare several studies mentioned in their report. One of the subject of the study is; "In co-operation with the parties concerned, develop a programme of cooperation among Developing Countries, with or without petrochemical feedstocks to promote the development of the Petrochemical Industry in those Countries."

This subject has been chosen a case study of a developing country which has previous experience in the Petrochemical industry. Turkish petrochemical industry is taken as the subject of this study. There are large differences among developing countries with respect to various aspects of technical and economic development e.g. the structure of market, the nature of feedstock and structure of capital formation. Such differences cause them to make close cooperation and benefit from each other as much as possible.

Within the framework of this study we will attempt to design an area of cooperation and emphasize the role of each one can play.

1.2 The Outline of the Study

Chemical Industry after 1950 has been based on cheap and abundant petroleum products and consequently petrochemical industry became prominent in the second half of this century. Between 1950 and 1970 most of the petrochemical plants were put on stream in the developed countries. After 1973 when oil emerged as a single factor which could deeply effect the economies of most countries, some of the developing

countries had already decided to establish their own petrochemical industries. Since this industry needs intensive capital and technology oil producing developing countries established petrochemical industry by importing license and technology from industrialized countries, the others who did not have enough foreign capital had to import both capital and technology.

Turkey has established its petrochemical industry during 1965-1970 onwards. First petrochemical complex was realized at Yarımca, near İstanbul between 1965-75. Second Petrochemical complex which is under construtions will be on stream towards the end of 1983.

During the establishment of Turkish Petrochemical Industry some financial, technical and marketing difficulties have been encountered. Furthermore to meet foreign component of the investment requirements Turkey had to receive financial loans from industrial countries. Therefore the development of Turkish Petrochemical Industry will be analysed as a case study. Area of difficulties met during different stages of implementation will be summarized and overcoming of these will be discussed in some detail. Other developing countries can benefit from Turkish experience on the petrochemical industry so that, a cooperation can be established among the developing countries. Area of cooperation will also be outlined in the last part of this study.

2. Development of Petrochemical Industry in TURKEY

2.1 Selection of Production Plants

The fast development exhibited by petrochemical industry throught the world in the fifties and continuing during following years made this industry into a main industrial sector. In view of this and utilization of naphtha obtained in the domestic refineries a pre-project report for Turkey's first petrochemical complex was submitted to the State Planning Organization in 1963. After approval of pre-project Petkim Petrochemical Co. was founded in April 1965 with the aim of establishing and developing the Petrochemical Industry in Turkey. The first five units of Yarımca

Petrochemical Complex namely; ethylene, Poliethylene, Chlor-Alkali, VCM and PVC came into operation in 1970. Dodecly-Benzene unit was brought into operation in 1972. Carbon Black unit in 1975, styrene, polystyrene and caprolactam Plants in 1975 came into operation. Selection of above mentioned product list as shown in Table 1 was based on Country's petrochemical demand. Plastic processing industry in Turkey was at the developing stage between 1960-70. After 1970 application areas increased. Consequently demand for plastic has not been met by local production. Therefore Turkey has decided to construct the second Petrochemical Complex in Aliağa. The second complex will encompass thirteen production unit at internationally competitive capacities, as shown in Table 2. The complex is planned to come on stream in 1983 and to reach full capacity by 1985.

Estimated total investment cost of the second complex based on the expenditures already incurred plus the planned expenditures up to 1983 including an adequate contengency factor for the Year 1983, will be around 2.2 billion dollars.

TABLE I MAJOR PETROCHEMICAL PLANTS

IN TURKEY

(Yarımca Petrochemical Complex)

Petrochemical plant	Produced By	Design Capacity(1000t/y)	Licensor	Engineering and Supply contractor	Year of Operation
Ethylene	PETKIM	30		Stone Webster	1970
	PETKIM	25		Eng.	1973
	total	55			
VCM	PETKIM	27	ICI-Solvay	Humphreys and Glasgow	1970
	"	27	Solvic	PETKIM	1976
	total	54	"		
PVC	PETKIM	26	"	CTIP	1970
	"	26	"	"	1976
	total	52	"		
LDPE	PETKIM	12	ICI	Sim-Chem	1970
	"	15	"	"	1973
	total	27			
Chlor Alkali	PETKIM	18	Olim Mathieson	Pintsch-Bamag AG	1970
	"	18	Chem, Co. "	Bamag-Verfahrens.	1975
	total			Tech. GMBH	
Styrene	PETKIM	25	UOP	Litwin S.A	1975
Polystyrene	"	15	Cosden Tech.Inc.	"	1975
DDB	"	10	CONOCO-UOP	Foster Wheeler Italiana	1972
Carbon Black	"	15	Phillips Petroleum	Euro Technics S.p.A.	1974
Caprolactam	"	25	Investa Erms	Nissho-Iwai Co.,	1976
SBR	"	32	Polysar	Heurtey	1975
CBR	"	13	"	"	1975
Budadien extraction	"	33	"	"	1975
Carbon Black (expansion)	"	15	Phillips Petroleum.	Snam Progetti	1981
DMT	SASA	60			1977
Polyester Fibers	" MNS	27			1968

TABLE 2 ALIAGA PETROCHEMICAL COMPLEX

PROJECTS	CAPACITY	LICENSOR
1. Chlor Alkali	75.000	Catalytic Int., Oronzio de Nora, Permelec SpA
2. Vinylchloride monomer	105.000	Solvay -ICI
3. Polyvinyl chloride	100.000	Solvay -ICI
4. High Density Polyethylene	40.000	Mitsui Petrochemical
5. Low Density Polyethylene	150.000	ICI
6. Polypropylene	60.000	Mitsubishi Petrochemical
7. Ethylene Oxide/Ethylene Glycol	68.000	Shell Research Ltd.
8. Phthalic Anhydride	30.000	Rhone Poulenc
9. Acrylonitrile	70.000	Sohio (Vistron)
10. Naphtha Cracking	300.000	Institute Francaise Ptr (IFP)(x)
11. Aromatics	124.000	UOP
12. Pure terephthalic acid	70.000	Standart Oil Co. (Amoco)

(x) For the Hydrogenation unit.

2.2 Selection of Process Licensors

Following criterias were used during selection of technology;

- The technology to be transferred should bring new processes to Turkey.
- The technology should be successfully operated at least in two plants.
- The degree of foreign depandance such as materials and equipment should be minimized.
- Contribution to the national economy should be maximized.

2.3 Selection of Supply Contractor

Generally supply contractor is an engineering company. They design the plant according to the basic design data obtained from Licensor. Before appointment of supply contractor client should look for his experience whether he has engineered and corpleted a similar plant at the same capacity or not before.

2.4 Term and Conditions of Contract

During construction of Plants separate contracts had been signed with licensor and supply contractor. Licence was based on paid-up royalty system. Concluded contracts were based on Guaranten Maximum Price with Supply Contractors. In this case saved amount of money from the ceiling price were shared between Petkim and the Contractor.

2.5 Selection of Site Contractor

Appointment of a foreign site contractor for construction and erection was a favorite model for Turkish Industry until 1970. First complex in Yarimca was constructed by Foster Wheeler Ltd of London. But after 1971 expansion of plants has been realized by Petkim. Furthermore the entire construction and erection of second petrochemical complex in Aliaga are continuing under the responsibility of Turkish contractors and Petkim.

2.6 Selection of Plant Site

The site chosen for both Yarimca and Aliaga complexes are at the coast and next to the refineries. Yarimca complex is some 80km.s far from Istanbul by road. A high proportion of the downstream consumer industries are situated in the area of Istanbul.

Aliaga complex is around 60 km. far from Izmir by road. Izmir area is the second potential market for plastic application after Istanbul. The roads connecting the Plants to the cities are well surfaced and carries a good deal of commercial traffic.

Rail access is available in Yarimca complex. But the nearest rail head for Aliaga is far a distance of 25 km. It should be stated that the rail access to Aliaga will be realized in the near future.

According to the present consideration transport and distribution in bulk will be done by sea for Aliaga petrochemical complex.

It is possible to have a product distribution terminal on the coast of Istanbul area a similar Centre on the southern coast of Turkey, both of which would be responsible for the further distribution of products to customers. Both Aliaga and Yarimca Petrochemical Complexes are provided with the harbour facilities for handling both solid and liquid products in bulk.

2.7 Operation Stage

Precommissioning and start-up activities took place in 1969 for Yarimca Petrochemical complex. The manpower required for operation e.g. plant operators, foremen, engineers and technicians were not available in full in that time. Therefore company applied an intensive training program in the country and in the licensor's similar plants outside of Turkey.

Contractors and licensors supplied one or more start-up engineers or operators to guide and advise the owner's operating staff. That expatriate supervisers stayed in Yarimca until company's operating

personal acquired adequate experience in operation. The foremen and operators required for process units are not easily available respectively with remaining required for offsites and general facilities. For offsites and general facilities the problems of acquiring adequate operating staff may not be too severe since these areas do not generally involve a high degree of sophisticated technology and personel can be drawn from many sectors of industry. During start-up of first complex of Turkey in Yarimca, Company supplied necessary operating personnel from refineries, and other chemical companies. For the Second Petrochemical Complex in Aliaga which will be in operation in 1983, Company will establish good estimate of the manpower that can be made available from the Yarimca Complex with experience of the particular process involved at Aliaga. From a timing point of view it is very important that the start-up staff are assembled and trained well before the completion of construction of the plants. They can then follow the final stages of construction in readiness for precommissioning.

2.8 Marketing

The first complex established by Petkim Petrochemical Co. in Yarimca in 1970 had the idea to provide Turkish home market demand. But because of the growth of the market in Turkey the domestic production was not able to meet the demand. Therefore import of petrochemicals had started and this will decline when new production units will come on stream in the second petrochemical complex in 1983. The imports of petrochemicals in Turkey are shown in Table 3. The estimated demand and production programme for the year 1983 is given in Table 4.

In the non-plastic products, the major units of the Second Petrochemical Complex in Aliaga, are acrylonitrile, ethylene oxide/glycol, phtalic anhidride and PTA (for polyesters). Both PTA and acrylonitride consumption are dominated by the Synthetic fibers industry.

For ethylene glycol, beside polyesters, the main market is in vehicle

coolant systems. Growth in Turkey can be expected in line with the growth in vehicle usage.

Phtalic anhydride has a varity of uses in Turkey. Plasticisers mad from phtalic anhydride provides a good market for P.A.

All domestic market forecast for above mentioned non-plastic products appear reasonable.

For plastics, there are mainly four products. Polypropylene is likely to maintain its position as the fastest growing of the major plastics, partly because of the natural growth of the market and partly by taking over at least a part of the market share at present held by high density poliethylene. For many application, there is considerable overlap in the technical suitablility of P.P. and H.D.P.E. Both PVC and LDPE are little affected by competition from other plastics. Their market arising mainly from substitution into the markets of natural materials or production of bulk low cost products. The impact of higher ethylene prices on final product may produce temporary consumer resistance, but there are few, if any, cheaper substitute materials available. Thus after a short period of readjustment, growth is likely to continue.

The establishment and development of the petrochemical industry is an essential part of the growth and evaluation of a modern industrial economy. Therefore development of this industry must be closely matched to the overall format of the economy of the country.

A petrochemical industry should not be regarded as a self contained entity on its own.

It's main reason for existence is to support major areas of the economy by providing raw materials for further and ongoing production processes.

The complexes must be planned in a manner which is responsive to the

TABLE 3 IMPORTS OF PETROCHEMICALS IN TURKEY
(in 100 tons)

PETROCHEMICALS	'68	'72	'74	'75	'76	'77	'78	'80
Benzene	55	*	84	20	165	300	180	144
Toluene	31	81	60	119	109	177	94	91
Xylene	16	33	96	143	229	280	214	338
Tri/per chlor ethylene	20	24	14	28	38	30	24	15
Polyvinyl chloride	183	159	209	233	233	377	239	141
Polyethylene	190	245	259	264	329	325	317	306
Polystyrene	59	133	73	156	51	104	45	22
Polypropylene	4	72	57	145	210	173	118	193
Polyvinyl acetate	-	-	-	-	-	-	-	-
SBR	137	137	148	133	46	28	77	20
CBR	8	291	2	1	2	*	3	3
Phthalic anhydride	24	34	29	6	12	22	38	13
Carbon black	93	156	169	7	83	74	43	3
Ethylene oxide	*	1	1	1	2	2	3	3
Ethylene glycol	8	58	104	113	137	357	329	205
Caprolactam	28	105	53	85	83	12	*	-
Acrylonitrile	*	31	98	145	223	283	263	297
Dimethyl terephthalate	1	108	208	230	473	269	4	3
Dodecylbenzene	46	110	10	27	69	117	41	92
Acrylic fiber	49	65	123	33	158	73	3	
Polyamide fiber	13	1	9	6	3	4	4	
Polyester fiber	55	-	30	42	6	*	-	
Polyamide yarn	24	8	10	14	57	62	46	
Polyesteryarn	12	4	10	11	3	2	2	

Remark * : Less than 100 tons

needs of the economy. There also needs to be an overall strategic plan for petrochemical development over fairly long time say twenty years period, which reflects likely trends in the economy and consequently the development of product pattern.

The Turkish feasibility study prepared for the first and second petrochemical complexes were based on a sound market forecast. The home market had a prime importance in the feasibility studies. Production capacities selected in 1965 for Yarimca complex was suitable in that time. But because of the fast development of domestic market indicated capacities became insufficient. Therefore more realistic and economic capacities projected in the second complex in Aliaga.

Naphtha is considered as a major feedstock for the Turkish petrochemical industry. Naphtha however, is a highly desireable product, not only within the refinery, but also for the fertilizer industry.

Because of the high cost of naphtha reflected to the product prices there is a reluctancy to use naphtha in the fertilizer industry in Turkey.

As an alternative feedstocks in petrochemical industry gas oil or LNG in the future should be considered in due course.

2.9 Onstream Factors

The onstream factors, in terms of operating hours to reach required annual production was 8000 hours per year for Yarimca petrochemical complex. During operation, this operating hours has never been met because of the needs of frequent maintenance shut down and power shortages.

Consequently, Aliaga Petrochemical complex has been designed according to the following operating hours;

UNIT	OPERATING HOURS PER YEAR
Naphtha cracker	6000
Cat Reformer/Aromatics	8000
VCM	6600
PVC	7200
HDPE	7200
LDPE	7200
Polyprophylene	7200
EO/EG	7200
ACN	7200
Clorine	6000

In practice, above mentioned figures are well established for a steady annual operation.

2.10 Financing

In the inquiry documents for both Yarimca and Aliaga Complexes, contractors were requested to provide outside finance for their own portion of the project. The Turkish company directly financed all expenditure inside Turkey. Government loans used either or a direct government to government basis, or as loans raised from commercial sources and insured through official government departments (ECGD, COFACE etc.). In some cases, like carbon black expention, DDB expention, project was financed through an international agency, IBRD.

Synthetic rubber plants was financed by European investment bank. Certainly, financing of projects became main difficulty in the development of the Turkish petrochemical industry.

2.11 Project Management

The second difficulty concerns the administration of project. In the period before 1965, Turkish industry had obtained construction and erection works on turn-key basis. Foster Wheeler Ltd. was the General site

contractor for the first petrochemical complex in 1968, besides supply contractors. In case of second petrochemical complex, however, a different path was followed. There was a number of alternatives to organise this complex. One of them was the appointment of a foreign managing contractor to handle the day to day activities directly involved, in getting the plant engineered, purchased and built. But the owner Petkim Petrochemical Co., had applied different system in this project as such : feasibility studies carried out by Petkim, to define plant capacities. Additionally following activities was taken by Petkim Petrochemical Co.

- Planning of the investment program
- Arranging finance and financial control
- Approval of Turkish engineering portion
- Review all engineering documents submitted for client approval
- Control of overall project costs
- Purchasing all Turkish equipment
- Bidding of construction and erection jobs within Turkish contractor
- Coordinating of contractors activities
- Training of operators and maintenance personel
- Pre-commission and commission complex.

As it can be seen from above list, there is not a managing contractor and Petkim Petrochemical Co. itself coordinates activities.

2.12 Operation Experience

Start up activity has to be planned very carefully. During operation of the first Petrochemical Complex in Yarimca, a large number of operators and maintenance personel have been provided by the owner, locally.

Outside companies such as contractors and licensors have assisted the owner by providing adequatly trained and experienced personnel.

After succesful start-up and normal operation expatriate operating personel left the complex. Another significant event during the operation is the power shortage. In the year of 1970, Petkim Petrochemical Co., had to face many problems arising from power shortage. Therefore emergency power generators had been put into operation in the first petrochemical complex. It is suggested that as a minimum at least two thirds of the power requirement of the plant should be established and generated within the petrochemical complex. The rest will come from national grid system. This target has been achieved in the second petrochemical complex. The number of spare parts required for equipments is very important also at the stage of operation, spare parts necessary for two years opeation of the plants should be made available in the warehouse at the beginning. After certain years of operation this amount may not be necessary at this level. Plants should be adequately provided with spare equipment. For example Naphtha cracking unit is the most complex and important plant of a Petrochemical Complex. Ethylene and propylene etc. produced from this unit are intermediates for other units of the Complex. If this unit stops, the complex will suffer from this event. Therefore special attention should be given to Naphtha cracking unit. Spare cracking furnaces have to be established additional to the necessary amount for operation. Cracking compressors must be double train. In the first petrochemical complex in 1968 Company put a singly train cracking compressor according to the advise of the supply contractor. But due to the mechanical failures, many shut downs have been faced during operation. As a resulution another cracking furnace has been put in Yarimca as a spare. Taking into consideration this experience in the second petrochemical complex naphtha cracking unit has been provided with double train cracking compressors.

2.13 Marketing in the Long Range

All developed countries of the world, over the past twenty years,

the rate of growth of the chemical industry has run significanly ahead of the rate of growth of the economy as a whole. The petrochemicals sector has itself set the pace for the chemical industry. This growth has been based upon the substitution of traditional natural materials by synthetic products, substantially on price grounds, as well on the development of new markets and applications for the new products.

Parallel to the developed countries, petrochemical industry has been taking place at an increasing pase since 1973, in some locations of developing countries. Such as Middle east, especially Gulf countries, far east regions.

In the Middle East Turkey has a special place in development of her petrochemical industry by making long range market forecast since 1964.

The demand and production program for the year 1983 indicated in the Fourth Five Year Development plan is given in the Table no. 4.

TABLE 4

PETROCHEMICALS	DEMAND (Ton) 1983	PRODUCTION (Ton) 1983
Benzene	110.000	152.700
Toluene	23.000	4.300
Xylene	120.000	175.000
Tri/Per Chloro Ethylene	7.500	7.500
PVC	136.000	127.000
Polyethylene	174.000	160.000
Polystyrene	40.000	15.000
Polypropylene	28.000	45.000
Polyvinyl Acetate	30.000	30.000
SBR	42.000	32.000
CBR	6.800	13.500
Phthalic Anhydride	30.000	40.000

(Table continued)

Table 4 continued

Petrochemicals	Demand (ton) 1983	Production (ton) 1983
Carbon Black	46.000	30.000
Ethylene Oxide	30.000	40.500
Ethylene Glycol	51.000	51.000
Caprolactam	24.100	25.000
Acrylonitrile	70.000	52.500
Dimethyl Terephthalate	53.000	60.000
Dodecylbenzene	36.000	24.000
Acrylic Fiber	62.000	70.000
Polyamide Fiber	7.000	14.000
Polyester Fiber	37.000	57.500
Polyamide Yarn	25.000	18.000
Polyester Yarn	28.000	30.000

2.14 Research and Development

Research and development centre of Petkim Petrochemical Co. has been established since 1969 mainly :

- To find solutions to the problems arising in the works,
- to upgrade and establish better and more economical areas of usage to the by products,
- to find better, more economical and preferably locally produced substitutes and alternatives to the chemicals and other materials used in the Company,
- to make developments on the present production processes to improve them and,
- to develope new processes.

Some of the works done are :

- Investigating the reasons of flooding of HCl distillation column in the VCM plant and checking its design calculations,

- Modification of brine purification process of the chlor-alkali plant
- Hypochlorite production from waste chlorine,
- Study of the cracking parameters of naphta cracking plant, to improve the properties of the pyrolysis gasoline,
- Markets development for the by-products of VCM, DDB and styrene plants and execution of laboratory research for this purpose,
- Development of a new feedstock from local resources for the Carbon Black plant in order to replace the imported aromatic oil,
- Development of a polymerization inhibitor system to be used in the compressors of the Ethylene plant,
- Alternatives to some catalysts used in the Caprolactam plant,
- Replacement of some chemcials used in polymerization recipies by locally produced one,
- Development of a recipie for production of expendable polystyrene suitable for manufacturing isolation blocks,
- Development of a polymerization recipie for production of PVC type suitable for battery seperator production,
- Full process development for production of tri and perchloroethylene from the chlorinated wastes of the VCM plant.

2.15 Turkish Experience in the Technology of Petrochemical Industry

2.15.1 License, Process and Project Engineering

In the period before 1965, Turkish Industry had obtained license, engineering, equipment supply, construction and erection works on turn-key basis. But Petkim ceased to obtain agreement on such basis and initiated the policy of making agreements for license, equipment supply and other services separately. The most recent technologies throughout the world were studied and examined abroad on sites by Petkim personnel and bids were obtained from as many bidders as possible. After evaluation of the said bids, agreements were made on the basis of paid-up or running royalty, fixed fee, guaranteed maximum price and at cost

accordingly minimizing the Turkish supply parts. The entire construction, erection and for some cases (as for VCM expansion) even detailed engineering and equipment supply services were carried out by Petkim itself. Recently, Petkim's policy has tended to tempt the foreign contractors to have partial or over-all local partnerships in doing their services.

2.15.2 Equipments and Services Supplied from Turkey

Equipment and materials with the below specifications can be included within Turkish supply:

- Carbon steel field tanks, spherical and torispherical head pressure vessels, columns, medium pressure heat exchangers.
- Cold water pumps, fans, totally enclosed fan cooled motors, transformers (up to 25.000 KWA), motor control center.
- Carbon steel pipes and fittings, plates, valves, flanges.
- Electrical cables, instrument cables.
- Instruments, single core copper tubes.
- Carbon steel belts and nuts, insulation materials, belt conveyors etc.

Equipment and materials other than stated above such as reactors, high pressure drums, compressors, ex-proof electric motors and pumps, stainless steel pipes and fittings etc. are imported.

100% of the work related to civil engineering, construction, piping engineering and electrical engineering can be performed in Turkey. Also, 30-40% instrumental works can be carried out locally.

There are many Turkish firms which have worked with Petkim and experienced in the petrochemical field.

2.15.3 Manpower Utilization

Since Petkim has put in operation the First Petrochemical Complex succesfully and carried out most of the engineering and equipment supply works locally during expansion of the original plants, Petkim presumes that

most of the manpower required to realize the Second Petrochemical Complex is available within Turkey. After the realization of the Second Complex, Petkim can be considered to be one of the experienced firms in the petrochemical industry.

2.15.4 Construction and Erection

Petkim has made contracts with Turkish firms for the construction and erection of Aliaga Complex.

The Turkish contractors have experienced erectors, pipe fitters and welders who work according to API standards. The construction equipments are imported and used at the sites. Construction and erection organizaiton of the Turkish firms are similar to the Developing Countries and in international standards.

3.0 Areas of Cooperation Among Developing Countries

The present international economic order is well-dominated by industrialised market economies as most characteristically observed in the existing world trade picture. Despite their relatively small populations, their collective share of world trade stays around 80%. As a matter of fact the developed countries import more than three-fourths of the raw materials exported by the developing countries. On the other hand, the Thrid World with its limited industrialization and underdeveloped technological level depends to a very large extent on manufactures and technology imports from industrialised countries. Furthermore, it is observed that the already economically powerful developed world continue to derive the benefits of almost complete integration reflected in active substantial trade relations and close economic ties with one another.

An additional indication of the aforementioned dominance is well reflected in the fact that the national currencies of the developed countries serve as the major convertible currencies in the world trade with

wide-ranging implications on the operation and control of the world monetary system. Finally it should be observed that the world capital markets and the majority of the powerfull multinationls are integral parts of these economies.

In the other hand the Second General Conference of the United Nations Industrial Development Organization (UNIDO) held at Lima, Peru, in March 1975, recommended that UNIDO should include among its activities a system of continuing consultation between developed and developing countries with the object of raising the developing countries' share in the world industrial output through increased international cooperation. In order to reach to this aim the developing countries should act together to the extend possible and trough economic and technical cooperation and integration schemes among themselves to face the industrialized world in unity.

In complience with the above mentioned resolution and the new economic order, areas of cooperations among developing countries have been stated below;

3.1 Technical Cooperation

The basic purpose of technical cooperation, as provided by the United Nations is to build up the productive capability and indigenous resources in the countries concerned by increasing the availability of the managerial, technical andministrative and research capabilities required in development process. Adding to the foregone description of the purpose of technical cooperation, the United Nations have made it distinctly different from the concept of technical assistance which revolves around a donor-recipient relationship. In contrast the process of technical cooperation is described as based on the concept of self reliance in which the partners or participats are engaged on an equal basis in a relationship of mutual help and support in achieving the

objectives of development activity. The concept of self-reliance implies "the will and ability to make self-sustained progress, without one-sided dependence on others, though by no means excluding balanced inder-dependence with them." Fufther, self-reliance is not to be understood as limited only to individual co ies, but it includes joint effort by groups of countries on the b of mutually complementary relationships. Based on the above unde anding, particularly in relevance to the concept of self-reliance in a relation of equal partnership of mutual help and support, the process of technical cooperation has largely come to be understood as aiming at the continued development and strengthening the national institutions by developing technical and skilled manpower through training and specialized education facilities, exchange of experts, skilled manpower and equipment, and engaging in organizing activities of operational nature leading to joint agreements, protocols.

Development and expansion of the information systems concerning technical information in the field of petrochemical industry is one of the main area of cooperation among developing countries.

The development of this industry is generally realised in three main developed regions: Japan, United States and Western Europe. Consequently licences are becoming available from the developed countries belonging above mentioned areas. Some of developing countries such as Turkey, India, Egypt and some of Gulf countries have technical experiences accumulated from their applications. The technical data and information stored in these countries would be retrieval and provided to the other developing countries. During the preparation of prefeasibility studies the developing countries can transfer aforesaid technical information one to another. For this purpose the developing countries should act together and maintain cooperation stated in the following abreviated version;

- Development and expansion of the information systems concerning

technical cooperation in the field of petrochemicals,
- Identification and improvement of the potentials of national institutions for technical cooperation aimed at strengthening their capabilities through joint efforts and sharing of experiences.
- Expansion of bilateral and multilateral arrangements for promoting technical cooperation and development of a legal and administrative framework covering the entry, employment obligations and privileges of experts, consultants, fellowships, use of contractors and other specialist services including the entry of equipment and supplies.
- Provision and support of personel, data and information to the training activities of the Petroleum or Petrochemical institutions with mandates to meet the immediate needs of technical manpower.
- Development and expansion of the technical Date Base System of the developing countries. This system can be developed within the activities of the Statistical, Economic and Social Research and Training Centre for Islamic Countries, Ankara-Turkey.

Petkim Petrochemical Company has an engineering and study department with qualified engineers in the field of Petrochemical. They are carrying out all feasibility studies to be prepared by the company and necessary for the country.

Additional to Petkim's engineering and study department number of engineering company also exist to make feasibility studies. These are mainly listed below:

- Tumas Engineering and Contracting Co.
- Tustas Engineering Co.
- Bimas Engineering Co.
- Boral Engineering Co.

During pre-feasibility study or feasibility study and license selection all necessary technical information can be provided by above mentioned companies.

The process of technical cooperation, besides being part of the above

noted activities, requires independent action in certain specific areas in order to generate and proliferate its effects in a multifarious manner towards the evaluation of various plans of cooperation and collaboration aimed at achieving the main purpose of development and progress with this in mind, action has to be started in the following specific areas of technical cooperation.

- Training and Research
- Exchange of engineers and technicians
- Education and followship
- Inventory of Consultancy Firms and Roster of experts

3.1.1 Training and Research

In view of importance of training technical personel such as process operator and maintenance people, the developing countries with less experience in the field of operation and maintenance should be able to send their personel to the other developing countries which has experience in the similar field. For example Turkey can accept applications from the developing countries on this matter. There are variety of Plants of Production on the petrochemical and non petrochemical products in Turkey belonging to the Governmental or private sector. If necessary, training in place also would be provided in case of a request by sending experts to the developing countries.

Petkim and Petrochemical Co. has research and development center in Yarimca. The description of this technical center was summarized in the previous pages. Petkim's research and development center will be developed to an petrochemicals research institute within coming years. There is a joint project with UNIDO Ankara on this subject. The Petkim's research and development center, thought in need for expanding their existing activities, is ready to cooperate with their counterparts in the developing countries.

3.1.2 Exchange of Engineer and Technicians

Another important area of technical cooperation is the development and exchange of skilled manpower. It should be remembered that the petrochemical industry requires highly specialized engineers, operators and maintenance technicians. During start-up and normal operation adequately experienced personel should be provided. In highly industrialized countries, even very large operating companies have difficulty in finding such personnel. Therefore exchange of skilled manpower among developing countries is becoming more important. In order to reach to this aim, technical manpower agreements with regard to the requirements and availability of personel should be established and encouraged.

3.1.3 Education and Fellowship

Another area of technical cooperation is to identify the institutions of higher education in the developing countries and to establish cooperation and coordination among them through various means including the development and launching of fellowship and scholarship programmes for the exchange of technical students and teachers.

3.1.4 Consultancy Firms and Roster of Experts

The information with regard to firms working in the area of consultancy and feasibility studies in the developing countries has also been very poor. An attempt has to be made to collect information in this area. Various library sources and other international organizations can also be tapped to obtain information on the subject so that a comprehensive directory listing all such concerns along with the addresses will be ready for the benefit of developing countries.

3.1.5 Conclusion of This Section

The above resume of activities, undertaken in the area of technical cooperation should be coordinated from a center which should be established by the developing countries. Similar activities in a larger area has been coordinated by "Statistical, Economical and Social Research Centre for Islamic Countries (SESRTCIC) in Ankara" for Islamic Countries.

3.2 Joint Ventures

The aim of joint ventures is to formulate a workable concept among developing countries.

There are a number of joint venture projects between Arab Countries and Turkish Companies such as :

1- Kirkuk (Iraq), Iskenderun (Turkey) pipeline project.

$ 550 m. and 981 kms. Kirkuk-Iskenderun pipeline project is a major product of good-neighbourly relation and fruitful cooperation between Turkey and Iraq. It was finalized late 1973. After the responsibility for the development and operation of the Turkish section, the project was assigned to Boru Hatlari ile Petrol Tasima A.S. (BOTAS) 99,9% owned by the state run National Oil Company (TPAO).

Construction works were completed by Consortium Groups namely Mannesman of Germany, Ballast of Holland, CMP of France and Tekfen of Turkey at the end of 1976.

2- The Arab-Turkish Bank

Agreement between Turkey and Libya has been reached and ratified by the Turkish Government on July 18, 1976 to create a joint venture (a Bank to promote and strengthen the economic and financial ties and assist in increasing the volume of foreign trade and other activities between the two countries.

Kuwait joined the Bank with a share of 20%.

3- Akdeniz Gubre A.S. (AKGUBRE)

Akgubre is another joint venture project between Turkish fertilizer Co. and Petrochemical Industry of Kuwait.

There are several areas of joint venture on the subject as listed below :

1. A joint venture company on engineering and study; to help countries participated on pre-feasibility study and detailed engineering of projects in the petrochemical industry.
2. A joint company in the field of operation and maintenance. This company will be very helpful especially for the Gulf Countries which are very close to each other. Joint venture company may however, establish branches in or outside of Gulf Countries.

3.3 Marketing

As is commenly known the rationale of situation energy-intensive industries near the sources of fuel and feed stocks is not any more subject to discussion. Since the primary energy costs now outweigh the sum total of costs for labour, plant construction, transportation to market and furthermore since in the petrochemical industry energy accounts for rather more than 50% of the costs of production, one would think that the supreme logic of placing petrochemical plants in a oil-producing country is established beyond any doubt. Therefore major petrochemical plants will be taken place in the Middle East soon. Supply of petrochemicals in developing countries is growing by about 15 percent per year. By 1987, 27 developing countries will have established plants to manufacture ethylene, compared to 13 countries with plants in existance in 1979; 16 of these countries will also produce propylene and 11 will produce butadiene. The biggest increase in capacity to produce basic petrochemicals will come after 1984,

e.g., ethylene capacity will be 7.9 million tons at the end of 1984 and an estimated 14.5 million tons at the end of 1987. Demand to the final products based on basic petrochemical is less than production capacities. Therefore there will be surplus of petrochemicals in 1990. What we are going to do with this surplus; long term arrangements between developing countries and developed countries on the marketing may be a good answer to the above question.

Turkey can enter to such a long term marketing arrangements especially with oil producing countries. Turkish petrochemical industry is based on naphta as a feed stock. Ammonia is used in the fertilizer industry. Crude oil for naphta and ammonia are improted from outside of country. In order to secure the supply of oil based raw materials multilateral arrangements will be appreciated. Production of non-plastic petrochemicals is well advanced in comparable to the other developing countries. Turkey may supply of these products to the other developing countries rather than production again in other developing countries.

4. SUMMARY AND CONCLUSIONS

4.1 Turkish Experience

Turkey started to build its Petrochemical Industry in 1965. The first Petrochemical Complex was designed for the production of ethylene based plastic raw materials. The purpose of the Petrochemical Industry was to develop Turkish Natural and Industrial resources by producing goods necessary for the Turkish national economy and that reserves of foreign exchange will be generated and conserved.

The Turkish Government fully supported the development of the Petrochemical Industry and therefore almost all technology, engineering materials and the financing of the Complex had to come from abroad. Turkish Government has supported the Petrochemical Industry, as much as possible but Turkey was not self sufficient in financing projects, therefore loans from Government to Government were accepted from Western Europe and Japan.

State run Petkim Petrochemical Co. hired an engineering consulting firm for execution of the project. They advised Petkim on the selection of technology such as licences and know how as well as the selection supply constructors. Based on experience it is recommended that an experienced consulting firm must be engaged by the companies which will start for the first time in the Petrochemical Industry.

During the selection of technology, engineering and supply contructors no difficulty has been encountered. The most complicated unit of a complex is the ethylene plant. At the stage of operation of the ethylene plant in 1968, the major problem encountered was with the mechanical equipment, especially some high pressure pumps failed to perform the duty for which were designed. These pumps had to be replaced with the suitable ones later.

The other problem was the power shortage faced during operation. In order to eliminate this problem emergency power generators were installed. Another important point is spare parts and equipments i.e., a reasonable amount of flexibility in the spare equipment must be provided to have continuous operation.

The operation time of the different units of a Complex should not be the same, for this reason an alternate design criteria was considered in the second Petrochemical Complex as such i.e., the design of intermediate units based on 6000 hrs/per year and product units 7200 hrs/per year as on stream time.

The Petrochemical Industry in Turkey has naphtha as its basic feedstock with the other important consumer being IGSAS (Istanbul Fertilizer Industries Co.) which produces ammonia and urea. After the completion of Aliaga Petrochemical Complex in 1983, Turkey's naphtha requirements will increase five to six time the present level. According to the projection on the domestic refining capacity made by the Turkish Petroleum Company, most of the naphtha requirements will be met locally, it should be born in mind that Turkey is not an oil producing Country and Turkey imports the crude oil required for Industry.

Quality-wise imports of sub-standard Petrochemical products, which were abundant on the Turkish market before start-up of Petkim production units, have been partially prevented.

Following the appearance of Petkim's products, the manufacture of good quality consumer good started and with the resultant encouragement of processing industry to produce durable end products, some exportt potential was created.

Another problem is the realization period for Investments. Both in the public and private sectors, investments tend to be longer to complete in Turkey.

This was mainly due to;

a) financing difficulties
b) shortages of foreign exchange
c) lengthy official formalities
d) Inadequancy of management in controlling all phases of projects.

Despite the fact the last two items have been partially overcome over the last few years, the first and the second are still in applicable.

The Turkish Petrochemical Industry has increased in line with the development in the capacity of the downstream industries, therefore the demand of Turkish home market is enough to absorb domestic production.

Today, in some areas the finished plastic product manufacturing industry is well advanced with greater capacity in PP. P.E. and PVC application in Turkey and raw materials have to be imported, finished manufactured and re-exported to the country of origin.

4.2 Areas of Cooperations

The Petrochemical Industry in the developing countries have expanded rapidly between 1970-1980. After 1980's exports will start from new Petrochemical plants built in the Arab Countries. As a result of this development, surplus Petrochemical products will exist in the oil producing countries. In this aspect long term arrangements between industrial developing and developed Countries will gain importance.

The following actions would be recommended;

- An information exchange system between developing countries on the technical and statistical basis should be established and directed from a center.
- In order to provide uniformity, raw materials and end products have to be standardized.

- Oil producing and non-oil producing countries have to come together and review their needs in financing, technical and marketing aspects.
- Additionally countries should encourage and facilitate the participation of consulting engineering and contructing services in the development projects of each other, including, building of infrastructure facilities.
- Take all the necessary steps to ensure the continuous and rapid flow of the goods by the other country's transit transport over their own territories,
- Encourage the development of Technical cooperation between themselves.

Above mentioned activities may lead in the future to the establishment of a common market of the developing countries as a whole or regional.

4.3 Relations of Turkey and Developing Countries

There is already established a good Cooperation between Turkey and developing countries especially Islamic Countries. Many joint venture projects have been accomplished in the past and many of them are under consideration. These area of Cooperations may be summarized within the following section;

- A credit foreign payment has been opened by United Arab Emirate to Petkim Petrochemical Co. to help them with the initial financing of their second Petrochemical Complex.
- Petkim Petrochemical Co. has offered to send qualified engineers and operators to Pakistan to support start-up activities of their Carbon Black Plant. This was requested by Pakistan Authorities as a result of the second consultation held in Istanbul, 22-26 June 1981.
- Petkim Petrochemical Co. has offered same type of start-up services for an ethylene plant to Libyan A. Jam. and to other Gulf Countries.

- On the marketing aspect, joint actions exist between private sectors of Gulf Countries and Turkey in the downstream, processing Industries.
- The Turkish contructors also can take important role in construction and erection of Petrochemical plants.

As a result, Turkey follows the principle of establishing fruitful relations with a large number of developing countries, especially with the neighbouring Islamic Countries.

References

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