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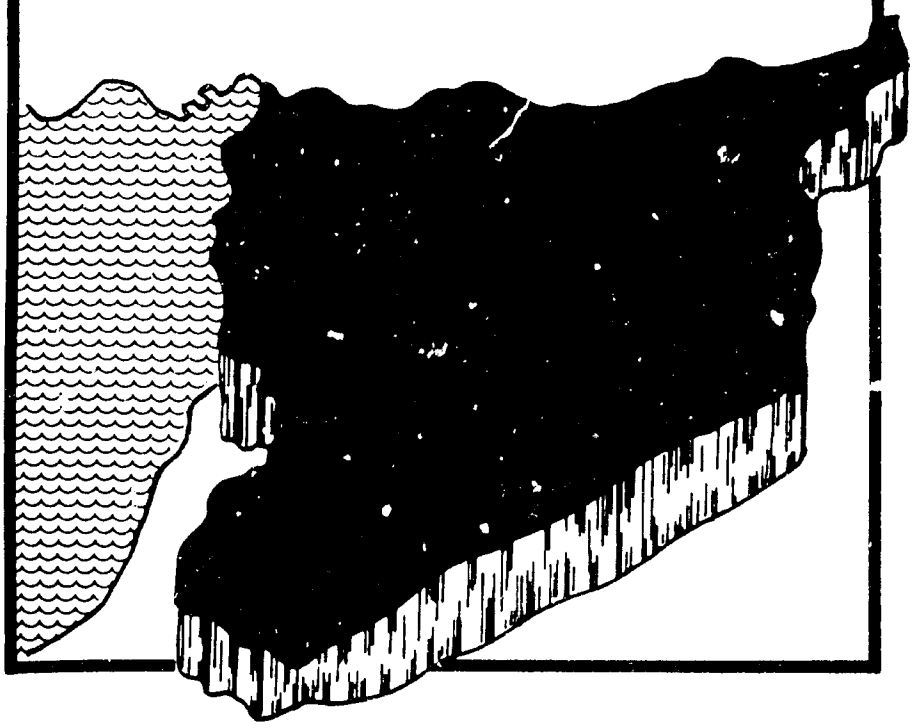

VOLUME VI

OTHER MODES AND RELATED INDUSTRIES

(Aviation, Pipelines, and Construction and Storage Industries)

LOUIS BERGER INTERNATIONAL, INC.

in association with

TIPPETTS-ABBETT-McCARTHY-STRATTON

MINISTRY OF TRANSPORT

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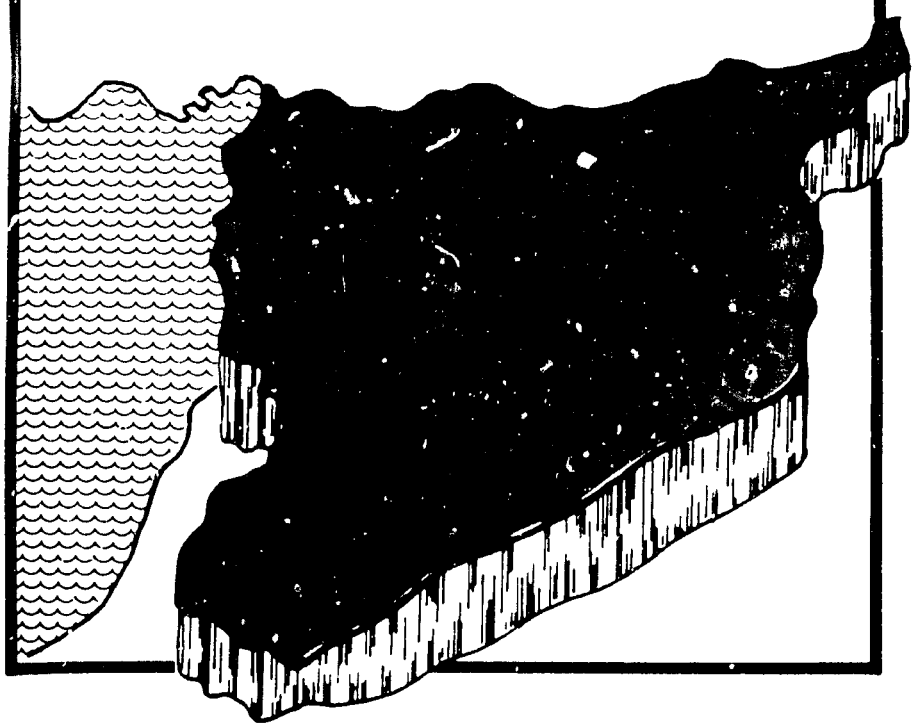

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This volume is one of seven produced as the Final Report for the Syrian Comprehensive Transport Study. The complete set of volumes is as follows:

Volume I	–	Executive Summary
Volume II	–	Transport Demand
Volume III	–	Railways
Volume IV	–	Roads and Road Transport
Volume V	–	Ports and Shipping
Volume VI	–	Other Modes and Related Industries (Aviation, Pipelines, and Construction and Storage Industries)
Volume VII	–	Transport Sector Plans

VOLUME VI

OTHER MODES AND RELATED INDUSTRIES

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PART I

CIVIL AVIATION AND AIR TRANSPORT

A. CIVIL AVIATION
B. AIR TRANSPORT
C. DEVELOPMENT PLAN
PERFORMANCE – AIR SECTOR

Glossary

PART I - CIVIL AVIATION AND AIR TRANSPORT

A/C	Aircraft
ACAC	Arab Civil Aviation Council
AFL	Airfield Lighting
AID	Agency for International Development
AIP	Aeronautical Information Publication
AMSL	Above Mean Sea Level
AOC	Airport Operators Committee
arr	arriving
ATC	Air Traffic Control
ATS	Air Traffic System
ATCC	Air Traffic Control Center
AVGAS	Aviation Gas
cl	class
CBR	California Bearing Ratio
dep	departing
DGCA	Director General for Civil Aviation
DME	Distance Measuring Equipment
dom	domestic
FAA	Federal Aviation Administration
FIR	Flight Information Region
IATA	International Air Transport Agreement
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
Intern	International
ITA	Institut du Transport Aerien
kv	kilovolt
kva	kilovolt-amperes
kHz	kilohertz
kw	kilowatt
LCN	Load Classification Number
Meteo	Meteorological
MHz	megahertz
mov	moving
MOT	Ministry of Transport
MTI	Moving Target Indication

VOLUME VI

Glossary (Continued)

NA	Not Applicable
NDB	Nondirectional Radio Beacon
NOTAMS	Notices to Airmen
nm	nautical miles
NR	Not Relevant
RVR	Runway Visual Range
SADCOP	Syrian Company for Storage and Distribution of Petroleum Products
SID	Standard Instrument Departure
SP	Special Performance
STAR	Standard Terminal Arrival Routes
TW	Taxiway
TBO	Time Between Overhaul
UNL	Unlimited
VASIS	Visual Approach Slope Indicator System
VDB	Very High Frequency Directional Radio Beacon
VDF	Very High Frequency Directional Finding
VHF	Very High Frequency
VOR	Very High Frequency Omnidirectional Radio Range

CALL SIGNALS

Domestic

ADB	Damascus
ALE	Aleppo
BN	Banias
DAL	Damascus
DAM	Damascus
DRZ	Deir Ez Zor
HAS	Al Hassakeh
KML	Kamishli
KTN	Al Quaryatein
LTK	Lattakia
MEZ	Damascus
PLR	Palmyra
TAN	Tanf

VOLUME VI

Glossary (Continued)

CALL SIGNALS

International

MUC	Munich
LON	London
PAR	Paris
ROM	Rome
ATH	Athens
BER	Berlin
CPH	Copenhagen
DXB	Dubai
DEL	Delhi
AUH	Abu Dhabi
BOM	Bombay
KHI	Karachi
DHA	Dhahran
SHY	Shinyanga
DOH	Doha
BAH	Bahrain
KWI	Kuwait
BGW	Baghdad
THR	Tehran
JED	Jeddah
SAH	Sana'a
BEN	Benghazi
TIP	Tripoli
TUN	Tunis
ALG	Algiers
LCA	Larnaca
SOF	Sofia
BUH	Bucharest
IST	Istanbul
MOW	Moscow
BUD	Budapest
PRG	Prague
AMM	Amman
TAP	Air Portugal
US	United States

CHAPTER A-1

SUMMARY AND RECOMMENDATIONS

Chapter A-1

SUMMARY AND RECOMMENDATIONS

INTRODUCTION

Syria is well launched into the jet air age. With one major international airport at Damascus, an alternate international airport planned at Aleppo, four regional domestic airports, a working air navigation system, and an airline serving many countries plus domestic routes, the groundwork has been laid for further improvements in domestic and international services and facilities to keep pace with projected passenger and cargo traffic volumes.

Still, many changes and investments must be made to improve all six airports, modernize the air navigation system, and change aircraft types to fit both the domestic and the international route structure of Syrianair.

Both Syrianair and the Directorate General for Civil Aviation (DGCA) must intensify and reorient their training programs to upgrade paraprofessional and lower level positions to provide better services to international airlines and more efficiently process passengers and cargo handling.

These general recommendations will have to be implemented if Syria is to keep up with or ahead of projected domestic and international air traffic through the remainder of the twentieth century.

TRAFFIC

The projections presented below cover international and domestic passenger traffic for Syrianair and total international passenger and cargo traffic at Damascus International Airport. These projections are predicated on the organizational recommendations and new equipment set forth above.

Projected domestic and international traffic is given in Table A-1.1. Serving the projected traffic through each of the target years will require the implementation of the following major recommendations or similar actions. All costs are in constant 1980 prices.

1. Air Navigation System

- A regional high-level traffic control center with advanced radar should be installed with the participation of Syria, Jordan, Iraq, and if possible, Lebanon.

Table A-1.1

TRAFFIC PROJECTIONS

(000)

Domestic (City Pairs)	1979[2]	1985	2000
DAM-ALP	6.1	40	141
DAM-LTK	-	19	67
DAM-PLR	-	-	6
DAM-DEZ	33.8	46	175
DAM-KAC	11.6	15	53
ALP-LTK	-	24	123
ALP-DEZ	-	15	61
ALP-KAC	4.2	11	42
Total Domestic	55.8	170	668

International[1]	1979	1985	2000
Total Passenger Movements Damascus Airport	929	2,352	6,784
Syrianair Passenger Movement	395	1,013	2,921
Total Cargo Movement Damascus Airport (Metric Tons)	7,021	23,500	68,000

1 Excluding transit passengers.

2 Statistical Bulletin for Aircraft Movement by sector 1979.

- The multitude of small FIRs (Flight Information Regions) should be consolidated.

- Domestic airways should be straightened out whenever possible to provide for the most flights between city pairs.

- New air navigation equipment, one VOR (Very High Frequency Omnidirectionnal Radio Range), and two DMEs (Distance Measuring Equipment) should be purchased in addition to the two VORs and two VOR/DMEs on order. Total costs for new air navigation equipment through 1985 are estimated at SP 29 million, not including the high-altitude control station equipment. Details are in Chapter A-4.

- The Syrian AIP (Aeronautical Information Publication) should be corrected and updated more frequently to reflect the changing status of air navigation, airways, airports, and landing aids. The AIP must reflect complete accuracy at all times.

2. Syrianair Aircraft Fleet

- On international services the present fleet of 747 SP (Special Performance) jumbos and Caravelles should be replaced by selling or trading them for more efficient aircraft, such as the B 727, that are better suited to the airline's route pattern and traffic volumes.

- For domestic services, the inefficient and obsolete Caravelle aircraft should be replaced with smaller, highly efficient turboprop aircraft such as the F-27. With good utilization, a fleet of three of this type of aircraft could serve projected traffic through 1985 with markedly increased levels of frequency and service.

3. Airports

- Master site plans should be prepared by qualified consultants for all five present domestic airports. This includes Aleppo, where an international airport is planned to serve foreign airlines and to provide an alternative to Damascus International Airport.

- The 1965 master plan for Damascus International Airport is fifteen years old and should be revised and updated by qualified consultants.

- A law or decree should be promulgated giving authority to the DGCA to enforce building zoning restrictions for the environs of all airports. Based on this legal activity, an aerodrome obstruction restriction map should be prepared and enforced at each commercial airport.

- Damascus International Airport

Even without an updated master plan, it can be determined that new investments at Syria's major airport through 1985 will amount to approximately SP 36.2 million in 1980 prices, mostly for navigation and landing aids. More precise requirements and cost estimates to increase peak hour capacity after 1985 will be possible only after the master plan is updated. However, the Consultants recommend required improvements between 1986 and 2000 that will cost an estimated SP 222 million. If a switchover from F-27s to B 737s is made in the 1986-2000 period, an estimated additional investment of SP 34.5 million for additional capacity and facilities will be required. Details on investments and costs are given in Chapter A-5.1

- Domestic Airports

Upgrading Aleppo to an international airport will require investments of SP 62 million through 1985 and an additional SP 55 million through 2000. Details are given in Section A-5.2. The remaining domestic airports will require investments totalling SP 81 million through 1985. Details are given in the investment schedules for these individual airports in Chapter A-5. Additional investment estimates for switchover from F-27s to B 737s in 1986-2000 have been made for the domestic airports of Aleppo, Lattakia, and Deir Ez Zor. Details are presented in the investment schedules of the respective airports.

PRIORITIES AND PHASING

The most urgent requirement in civil aviation is to update the master plan at Damascus International Airport and conduct master plan site surveys at the other five airports.

Priorities thereafter for Damascus and the domestic airports are set forth in Table A-1.2. Airport priorities are based on projected traffic. Current investment plans and commitments have been taken into account and are analyzed in Chapter C-1.

CIVIL AVIATION TRAINING

The DGCA, in cooperation with Syrian Arab Airlines (Syrianair), will complete a major joint United Nations Development Programme (UNDP) and International Civil Aviation Organization (ICAO) project to upgrade the air transport sub-sector in 1981. The terminal report on results of this work will be reviewed by UNDP/ICAO, and a follow-on plan will be prepared on the basis of accomplishments. Implementation of new UNDP/ICAO work should start in 1982 and will be directed at critical areas identified by the review.

Table A-1.2

SUMMARY OF INVESTMENT RECOMMENDATIONS

	Year	Investment (000 SP)
A. Damascus International Airport		
Through 1985		
Update Masterplan	1980	780
Apron Extension	1980	6,000
3 Three-bar VASIS	1980	1,050
Modification New Terminal Building	1980	5,000
ILS Category I	1980	2,450
Approach/AFL Lighting	1981	2,730
Other	1982	13,430
Contingencies		4,760
Subtotal through 1985		36,200
1986-2000		
Apron Extension		20,000
Terminal Building Extension		100,000
Domestic Terminal Building		15,000
Runway Extension		8,000
Expansion of Heating/Cooling Plant		20,000
Extension Catering Building		5,000
Cargo Handling Equipment		10,000
Contingencies		44,000
Subtotal 1986-2000		222,000
B. Aleppo International Airport		
Through 1985		
Masterplan	1980	800
Pavements	1980	12,270
Terminal Building/Tower	1980-81	23,000
Fire & rescue	1981	6,550
VASIS/Air Navigation	1982	3,200
Airfield Lighting	1982	3,400
Other	1981-82	4,580
Contingencies		8,100
Subtotal through 1985		61,900

Table A-1.2 (Continued)

SUMMARY OF INVESTMENT RECOMMENDATIONS

	Year	Investment (000 SP)
1986-2000		
Parallel Taxiway	1990	18,000
Runway/Taxi Overlay	1994	3,600
Terminal Building Extension	1994	12,000
Runway/Taxiway Shoulders	1995	5,000
Apron Extension	1991	6,000
Contingencies		11,000
Subtotal 1986-2000		55,600
C. Other Airports		
Through 1985		
Masterplans	1981	640
Pavements	1981-82	5,280
Terminal Buildings	1981-82	19,000
VASIS	1982	5,460
Airfield Lighting	1983-84	14,230
Other	1982-85	25,640
Contingencies		10,550
Subtotal		80,800
D. Total		
Through 1985		224,500
1986-2000		277,600
E. Additional Invesment Requirement for Switch over from F-27 to B737, 1986-2000		
Through 1985		None
1986-2000		
Damascus Airport		34,500
Aleppo		11,250
Lattakia		8,000
Deir Ez Zor		34,000
Subtotal		87,750
F. Grand Total 1981 - 2000		589,850

Note: VASIS = Visual Approach Slope Indicator System.
ILS = Instrument Landing System.
AFL = Airfield Lighting.

Further strengthening of Syrian civil aviation sufficient to meet ICAO standards should occur when the new Arab Civil Aviation Academy in Amman, Jordan becomes operational.

Operators and maintenance technicians for the new VOR/DME equipment to be installed in 1980 are being trained at the manufacturers' plants, so there should be no major problems in adapting to this equipment.

The Civil Aviation School in the DGCA has recently presented a preliminary plan to the Ministry of Transport for a new expanded Training Center at Damascus Airport. This school is needed, as present facilities will prove inadequate for any expansion of the Syrianair fleet and the up-grading of major airports.

Training of paraprofessionals - supervisory and skilled or semiskilled - in ground handling and customer services within Syrianair is still required. Syrianair has included courses in this area in its 1980 training program, but based on the amount of funds allocated for training and the numbers of employees covered, the effort is minimal.

It is recommended that this area of training be expanded - not at the expense of other areas but by additional funding. Closer coordination with the Civil Aviation School of the DGCA is also recommended. In particular, the schools could share classroom space and some training aids.

Syrianair has also requested the services of a foreign aviation expert to work with the Director of Training to upgrade all training. This is an urgent need, and the Consultants recommend that this expert be obtained as soon as possible.

CHAPTER A-2

ORGANIZATION AND TRAINING

Chapter A-2

ORGANIZATION AND TRAINING

GENERAL

The DGCA was established under Legislative Decree 137 in November 1961 and was incorporated into the Ministry of Transport when the latter was established in 1974. The organization and functions of DGCA are defined in that decree and in various organizational orders issued subsequently, the most important of which was to create a separate Air Traffic Service Directorate. This new directorate has yet to be legally approved.

The basic civil aviation structure of the Syrian Government was established earlier under Legislative Decree 101 in 1949 and was periodically modified over the years through numerous supplementary laws. This decree, and its amendments are, unfortunately, ambiguous in their description of the jurisdiction of the various organizations involved in the regulation and operation of Syria's civil aviation services and facilities. In fact, Decree 101 does not even identify air traffic control as a government function. In addition, some air traffic control organizations have been developed and operated without having explicit legal authority. The decree also does not acknowledge any of the signatory treaties and conventions made subsequent to 1949. Finally, the decree is not consistent with the laws of neighboring countries with which Syria has a common interest.

The shortcomings of Decree 101 have been recognized, and in 1971 the Arab Civil Aviation Council ratified a proposed new Aviation Law for Arab countries. Syria and Jordan subsequently formed a committee to review the proposal and to develop legislative proposals to be presented to their legislations. Jordan has accepted the law essentially as proposed. Syria is awaiting only presidential signature for approval.

The proposed law will be a considerable improvement over Decree 101 and its numerous appendages. It resolves the noted ambiguities and provides a sound legal basis for all essential aeronautical services. It also conforms with the International Civil Aviation Convention signed in Chicago in 1944 and with other international agreements to which Syria is signatory. The Chicago Convention and its annexes contain the standards and recommended practices which are the basis for international recognition of aircraft airworthiness, airmen qualifications, operator competence, and rules of the air. The convention also contains standards and practices for provision of aeronautical services, including navigation, communications, air traffic

control, meteorology, search and rescue, and airports. Syria ratified this convention in 1949. Ratification obligates the signatory to comply with the standards published in the various technical annexes. Noncompliance in any respect must be reported to the ICAO. Syria has incorporated this body of technical standards into its own national law with few exceptions.

Starting in 1976 Syria and Jordan have also been jointly developing a comprehensive aeronautical code based on the ICAO standards and practices. This code will provide regulatory uniformity in these countries and eliminate the ambiguities in current Syrian regulations. It cannot be adopted, however, until the National Aviation Law noted earlier has been ratified.

INTERNATIONAL AGREEMENTS

In addition to the Chicago Convention, Syria is also signatory to the Warsaw Convention of 1929 and the Hague Protocol of 1955 which define the responsibilities and liabilities of air carriers in international air commerce. However, the International Transit Agreement and the International Air Transport Agreement, amendments to the Warsaw Convention, have not been accepted by Syria. Several other Arab agreements which Syria has signed indicate the growing Arab regional cooperation. These include:

- Agreement of the Civil Aviation Council of Arab States, 1967,

- Organization of International Arab Airlines, 1966,

- Arab Transit Agreement, which permits airplanes registered in Arab states to fly in Syrian airspace and land at Syrian airports for non-commercial purposes, and

- Cooperation Agreement, 1974 - covering collaboration among Arab states in search and rescue operations.

Syria has declined acceptance of the following international agreements:

- International Transit Agreement,

- International Air Transport Agreement,

- Rome Convention, and

- Geneva Convention.

Syria has membership in the following International Organizations:

- the International Civil Aviation Council created by the Chicago Convention,

- the Union of International Airports, and

- the Civil Aviation Council.

Syria has signed an agreement, which has yet to be ratified by the Government, to be a member of the new Arab Civil Aviation Academy. This Academy is currently being established in Amman, Jordan, with the primary objective of developing and improving civil aviation and air transport in the member states. The Academy will present high-level courses in airport management, search and rescue operations, airline industrial operations, fire-fighting, airport engineering, and communications. The Academy is still in its formative stages. Guidelines for its first master plan will be developed at its next bi-annual meeting in October 1980.

BILATERAL AIR TRAFFIC AGREEMENTS

Since 1950 the Government of the Syrian Arab Republic has negotiated bilateral air traffic agreements with 32 countries. Most of these have been amended from time to time. Table A-2.1 lists the countries where agreements are in effect, the Syrian instrument of ratification, and the date that the basic bilateral agreement was negotiated.

Organization

Figure A-2.1 shows the de facto organization of the General Directorate of Civil Aviation based upon Decree 137 and its amendments, and organizational orders. There are now eleven directorates (departments) reporting directly to the Director General of Civil Aviation plus an Aviation School and three airport offices.

This span of control is much too great and diversified to be effectively managed by one person. The major recommendation the Consultants make regarding the overall DGCA organization is that positions be created for two Deputy Directors General. These people would be given direct line authority and responsibility for their assigned areas. One deputy should handle all airport affairs. The following offices and directorates should report to him directly:

- Aleppo Airport Directorate,
- Damascus Airport Directorate,
- Al Kamishli Airport Office,
- Deir Ez Zor Airport Office,
- Lattakia Airport Office, and
- all additional airport offices.

In addition, the present Assistant Director General should be made the other Deputy Director and given more direct line responsibility and authority over the other general office directorates of DGCA. At present, he primarily undertakes assignments given him by the Director General but does not formally have required day-to-day responsibility or line authority over the directorates.

As the DGCA grows, it may be desirable to strengthen control over technical areas, particularly those relating to flight safety. Another Deputy Director General should then be considered with direct authority/responsibility for the Inspection, Engineering, Air Transport, Telecommunications, Air Traffic Control, and Aviation Safety Directorates.

One Deputy General Director would then be responsible for administration and financial matters presently carried out by the Financial, Administrative Affairs, and Planning Directorates.

The Civil Aviation School should continue to report directly to the Director General since its functions span all departments.

At present, the various departments under each of the headquarters directorates, particularly the technical ones, are understaffed. Most departments have only the department manager and one or two other professionals at most. The Consultants question the need for activating these small departments within the directorates until they can be properly staffed. More effective use could be made of these professionals if they performed their functions as an integral part of the directorate to which they belong.

The functions of these departments and staffing have been reviewed, and the Consultants have no additional recommendations except to note that the Aviation Safety Directorate does not have a qualified pilot on its staff. This omission should be rectified as soon as possible since this department is involved

Table A-2.1

BILATERAL AIR TRAFFIC AGREEMENTS

Country	Instrument of Ratification	Date
Holland	Law No. 13	19 July 1950
United Kingdom	Law No. 49	4 April 1955
Switzerland	Law No. 50	4 April 1955
Pakistan	Law No. 51	4 April 1955
United States	Law No. 71	4 April 1955
Sweden	Law No.136	10 Dec., 1955
Egypt	Law No.185	21 Feb., 1956
Denmark	Law No.211	15 March 1956
Norway	Law No.396	15 May 1957
Belgium	Law No.487	16 Dec., 1957
Hungary	Legislative Decree 85	6 March 1963
U.S.S.R.	Legislative Decree 86	6 March 1963
Poland	Legislative Decree 87	6 March 1963
Saudi Arabia	Legislative Decree 25	13 June 1964
Bilgaria	Legislative Decree 85	16 May 1965
Cyprus	Legislative Decree 86	16 May 1965
France	Legislative Decree 151	24 Dec., 1966
East Germany	Legislative Decree 53	16 May 1967
Luxemburg	Legislative Decree 54	16 May 1967
Yugoslavia	Legislative Decree 55	16 May 1967
Czechoslovakia	Legislative Decree 1	12 Jan., 1969
Algeria	Legislative Decree 2	12 Jan., 1969
Iraq	Legislative Decree 64	3 March 1970
Libya	Legislative Decree 52	21 Jan., 1973
Afghanistan	Legislative Decree 16	15 Febl, 1974
Greece	Legislative Decree 103	25 Sep., 1974
Roumania	Signed	14 Aug., 1958
Yemen	Signed	Aug., 1971
Austria	Signed	May 1974
Morocco	Signed in Morocco	13 Dec., 1974
Tunisia	Signed in Tunisia	14 Oct., 1975
Republic of China	Signed	Nov., 1975

Note: Syria also has bilateral agreements with Italy, Kuwait, Spain, Korea, and Cuba.

EXISTING ORGANIZATION
DIRECTORATE GENERAL OF CIVIL AVIATION

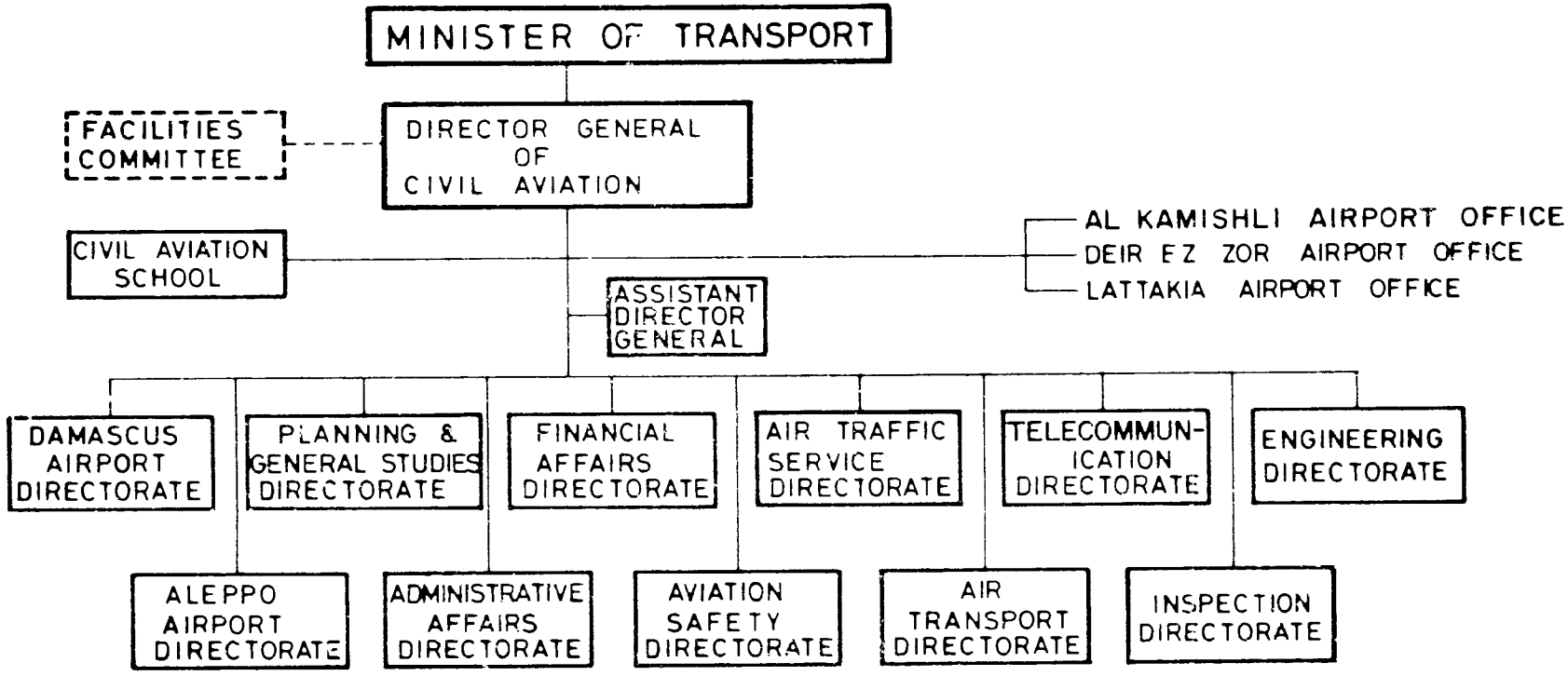

FIGURE A-2.1

in reviewing pilot certification and qualifications, among other safety related items. Finally, the Inspection Directorate, which consists of only the manager, is obviously inadequately staffed to accomplish its functions. It is recommended that at least one aviation engineer and one mechanical engineer be added.

In addition, a number of qualified air traffic controllers, some of them trained abroad, have been assigned to routine jobs at Damascus Airport which do not require their unique skills. It is recommended that the DGCA recruit recent engineering graduates interested in aviation as a career and rotate them through the various airport functions. The air traffic controllers, unless they desire to leave their specialty, should be given the chance to continue in it.

The Facilities, or Airport Liaison Committee, comprises representatives from Syrianair, airport security, immigration and customs, and sanitation and health. It is chaired by the Director General of Civil Aviation but has not met for a long time. It is recommended that this committee be activated; that it meet on a regularly scheduled basis (at least every two months); and that it develop an agenda and priorities to address the basic problems of airport management and operations noted elsewhere in this report.

UNDP/ICAO PROGRAM

A major program that has been conducted in parallel with the 4th Five-Year Plan is a UNDP/ICAO program to improve the efficiency of the air transport sub-sector so that it can "contribute more effectively to the development of tourism and trade as well as improving the safety of air transportation."

This SP 1,111,500 program will be completed in 1981. The last year of the program will include surveillance radar courses for controllers and maintenance technicians to handle the new equipment being installed.

Upon completion of the program, results will be reviewed by UNDP/ICAO and a follow-on plan prepared by an ICAO team. Future training will focus on critical areas of flight safety and those identified by the review as requiring future training. Outputs of the program will be:

- preparation of a management and organization manual for Syrianair,

- preparation and implementation of a maintenance organizational and procedures manual,

- establishment of an inspection organization and a technical records section, and development of manuals for inspection, operational control procedures, and operations,

- updating of national civil aviation regulations for increasing operational practices and airworthiness,

- organization of the economic aspects and structure of the Syrianair,

- management policy development and planning for training for both civil aviation and Syrianair,

- establishment of an airline training organization,

- organization of procedures for collection and analysis of air transport statistical data for market research and route network evaluation,

- on-the-job training in production control, maintenance scheduling, and inventory control,

- establishment of Syrianair's Technical Department as an approved maintenance operation, and

- fellowships for training in various flight safety specialties.

Completion of this work in 1981 will fill many gaps in the present capabilities of both the DGCA and Syrianair. Since this work will be reviewed by UNDP and ICAO and a follow-on plan will be based on results of this review, the Consultants believe that most areas of aviation improvement are well covered. This will be particularly true when the new Arab Civil Aviation Academy in Amman also becomes operational. The only recommendation at this time is that the DGCA should be provided with an expert airport architect to work with the directorate during the early phases of its airport expansion program. Details on this support follow.

Advisory Services

The Consultants' proposed building of new airport facilities throughout Syria and modification of the Damascus terminal will require the services of an airport architect early on. This area is not currently covered by the UNDP/ICAO program. It is therefore recommended that such an expert be retained to do the following:

- Review existing and new plans for terminal construction at the five major sites, as recommended by the Consultants, and

prepare preliminary engineering specifications or changes where required.

- Inspect the new Damascus terminal for any improvements that can be made at this late date in its construction.

- Review development and expansion plans for all terminals and make appropriate recommendations.

The length of the assignment of this expert should be at least three months. He should be an accredited or registered airport design architect. He should have had at least ten years experience in designing and supervising new airports. Experience in developing countries is most desirable. English language proficiency is mandatory; Arabic language capability is a plus factor.

CHAPTER A-3

AIR TRAFFIC ANALYSIS – DAMASCUS INTERNATIONAL AIRPORT

Chapter A-3

AIR TRAFFIC ANALYSIS - DAMASCUS INTERNATIONAL AIRPORT

BACKGROUND

During the decade 1969-1978, Syria experienced a 370 percent increase in passenger traffic at an average annual increase of 18.8 percent. Air cargo during this period increased a total of 296 percent for an average annual increase of 16.5 percent. The 1973 reversal of air transport growth is readily explained by the war that year. However, for the remainder of the period, air traffic reflects the considerable effort to develop new industrial, commercial, and agricultural sufficiency in the 3rd and 4th Five-Year Plans, the stimulation of foreign trade, and the purchase of services abroad in support of these developmental activities. There is also evidence that imports have been stimulated for a large part of the decade as a deliberate device to ameliorate inflationary pressures in Syria. However, renewed import restrictions in 1977 and 1978 are reflected in the air traffic plateau which occurred in those years, as shown in Figures A-3.1 and A-3.2.

Between 1973 and 1976 air passenger traffic at Damascus trebled for an average annual increase of 44.2 percent. Most of this vigorous growth can be described as "catch up" following the war and the reconstruction effort supported by external aid. A natural expectation is that the growth rate would have abated once these temporary stimulants were exhausted. Although several other nations of the Middle East were similarly affected as an aftermath of the 1973 war, no other airport of the region matched this level of air passenger growth; the average annual increase of the Middle East as a whole during this period was 28.1 percent.

The 1976 passenger movement count at Damascus represents a 42.6 percent increase over 1975. It is estimated that approximately one-third of this growth is the result of diversion from Beirut which, until the Lebanese civil war, had served as a gateway to the Middle East. This diversion is estimated to be 10 percent of the 1976 total count at Damascus. The extent to which traffic diversion from Beirut may represent a permanent accession for Damascus is still not clear. Much of it has returned to Beirut with the reopening of that airport. In any event, the 1976 diversion is an increment of growth which will probably not be repeated in future annual growth rates.

The remaining 28.4 percent growth in 1976 can be attributed to the accelerated economic activity associated with the postwar reconstruction, the increase in external aid, particularly from

oil-rich neighbors, the increase in the rate of oil production in Syria, the unprecedented escalation of international petroleum prices and the consequent easing of import restrictions and access to foreign exchange. These factors could not be expected to continue at the same expansive level; accordingly, some moderating of the 1976 rates of growth would be expected and did indeed occur in 1977 and 1978.

The plateau in 1977 and 1978 was influenced by the termination of aid from Iraq and Saudi Arabia, the termination of the oil transit agreement with Iraq and the loss of pipeline revenues, the closing of the Iraq border to transit traffic, the unexpectedly sharp rise in domestic fuel consumption, which reduced the oil export revenues, an increase in balance of payment deficits, and the subsequent reimposition of stringent import controls. These factors depressed import levels and resulted in a corresponding softening of air transport demand.

On the basis of the foregoing, trend corrections could be made to smooth out the growth curve for the decade 1969-1978. For the whole of the post war period (1974-1978) there is close agreement between air traffic growth at Damascus and the rest of the Middle East, both responding in large part to the substantial regional increase in oil revenues. However, a projection based solely upon the 1974-1978 growth is overly optimistic since the more significant factors producing this high level of growth cannot be expected to continue.

Subsequent to the development of the forecast for the current study, a forecast developed by Boeing Commercial Airplane Company[1] in 1978 was reviewed. This forecast was developed as detailed route-by-route analysis of total traffic to and from Syria (Damascus and Aleppo) and the share of traffic to be captured by Syrianair. The forecast used 1977 as the last year for which data were available. The methodology is in fact far more elaborate than that used here and relies on a large data bank of background statistics over individual airline routes. The results of the Boeing study are remarkably similar to the results of the present forecast, being within 7 percent. In 1985 the Boeing study resulted in a forecast of 967,000 international passengers through Damascus in 1979; this compares to the actual flow of 929,000. The 1985 Boeing forecast is 2.2 million, compared to 2.35 million used in the present analysis and outlined in the next section.

In analyzing the long-term impacts of the more significant factors influencing domestic economic activity and the purchase

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[1]Boeing Commercial Airplane Company, Syrian Arab Airlines, Planning for Growth 1978-1985, November 1978.

of goods and services abroad, the Consultants note that the rate of escalation of international fuel prices will probably not continue, nor can the rate of increase in crude oil production and refining capacity in the Middle East. As a consequence, there may well be a moderating of external aid from Syria's neighboring countries. Syria's own oil production, which was a major generator of foreign exchange, has leveled and the threefold increase between 1973-1977 is not likely to recur. Indeed, it w ll be a challenge to retain the present level of oil income in view of the considerable pressures already existing for increasing fuel consumption internally.

Furthermore, the existence of currency restrictions has been motivated in major part by the unfavorable balance of payments of recent years. The greater the risk of depleting foreign reserves, the greater have been the constraints created to limit access to foreign currency and the tighter the restrictions on purchase of services and goods abroad.

Foreign and Syrian businessmen are the most important segment of air passenger demand; it is clear, therefore, that the most important single condition of all which will shape air transport demand for the next decade will be availability of foreign exchange and the gross capital investment which it generates.

Syria possesses worldwide attractions in its numerous monuments of historic interest. These structures are unique physical representations of antiquity. However, it does not appear that tourism played a major role in stimulating air transport during the 1970s. The decade was characterized by political instability throughout the Middle East that created a public perception of hazard and travel uncertainty. Moreover, the development of accommodations for foreign travelers in Syria has barely kept pace with the needs of visiting businessmen, and it, as well as the necessary supporting infrastructure, has been inadequate to attract a significant flow of tourists from abroad.

Although the trends described above can be identified with reasonable certainty, there are several segments of the air transport market in which generalized, empirical judgments can be made but which lack precision and in some respects are speculative. No accurate quantitative measure of the principal constituents of the air passenger population appears to exist. In the absence of such data, an in-flight survey was designed and the cooperation of airlines serving Damascus sought. Not all airlines cooperated, but results were obtained from a number of important carriers.[2] In all, about 1,200 questionnaires were completed and the results tabulated (see Table A-3.9 at the end of this chapter).

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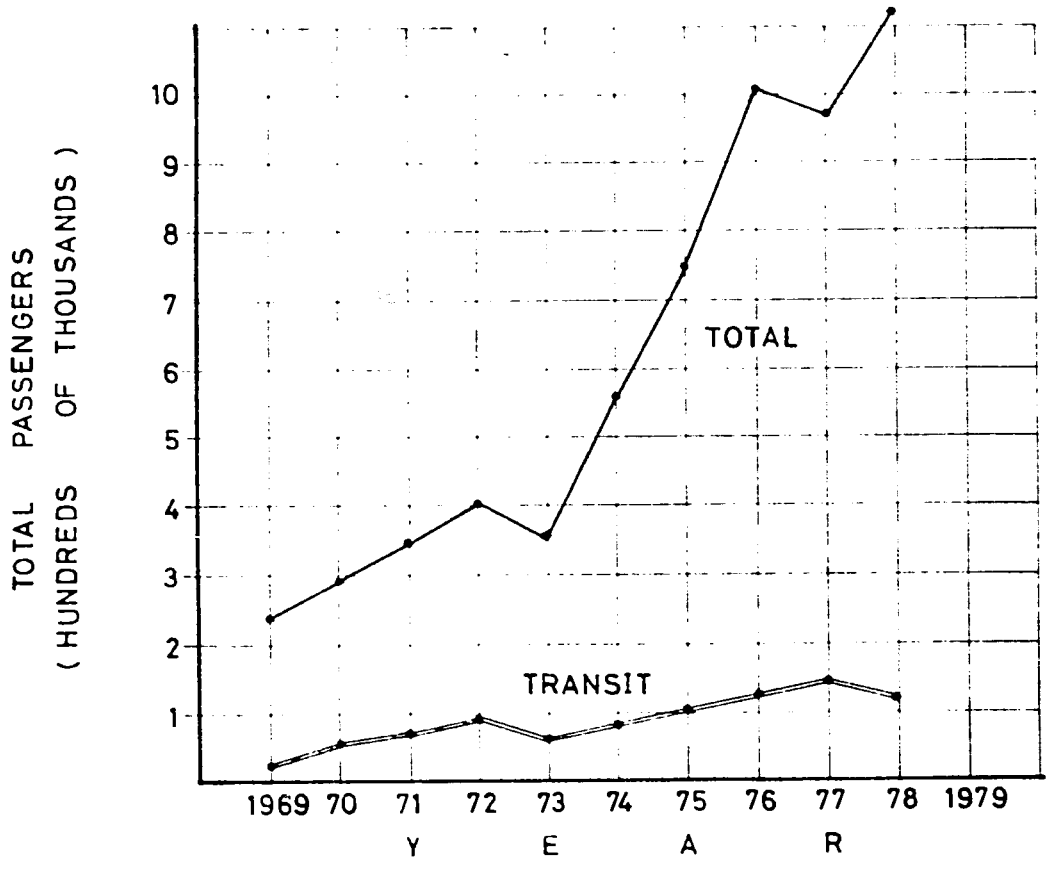
[2]Syrianair, British Air, SAS, Cyprus Airways, Alitalia.

DAMASCUS INTERNATIONAL AIRPORT

PASSENGER MOVEMENTS



YEAR	PAX (THOUSAND)	
	TRANSIT	TOTAL
1969	26.3	238.2
1970	55.6	290.5
1971	64.4	348.6
1972	95.1	400.7
1973	67.8	359.1
1974	82.5	562.2
1975	102.6	754.8
1976	126.9	1076.8
1977	147.2	970.8
1978	127.7	1119.6
1979	66.6*	498.7*

* = 6 months

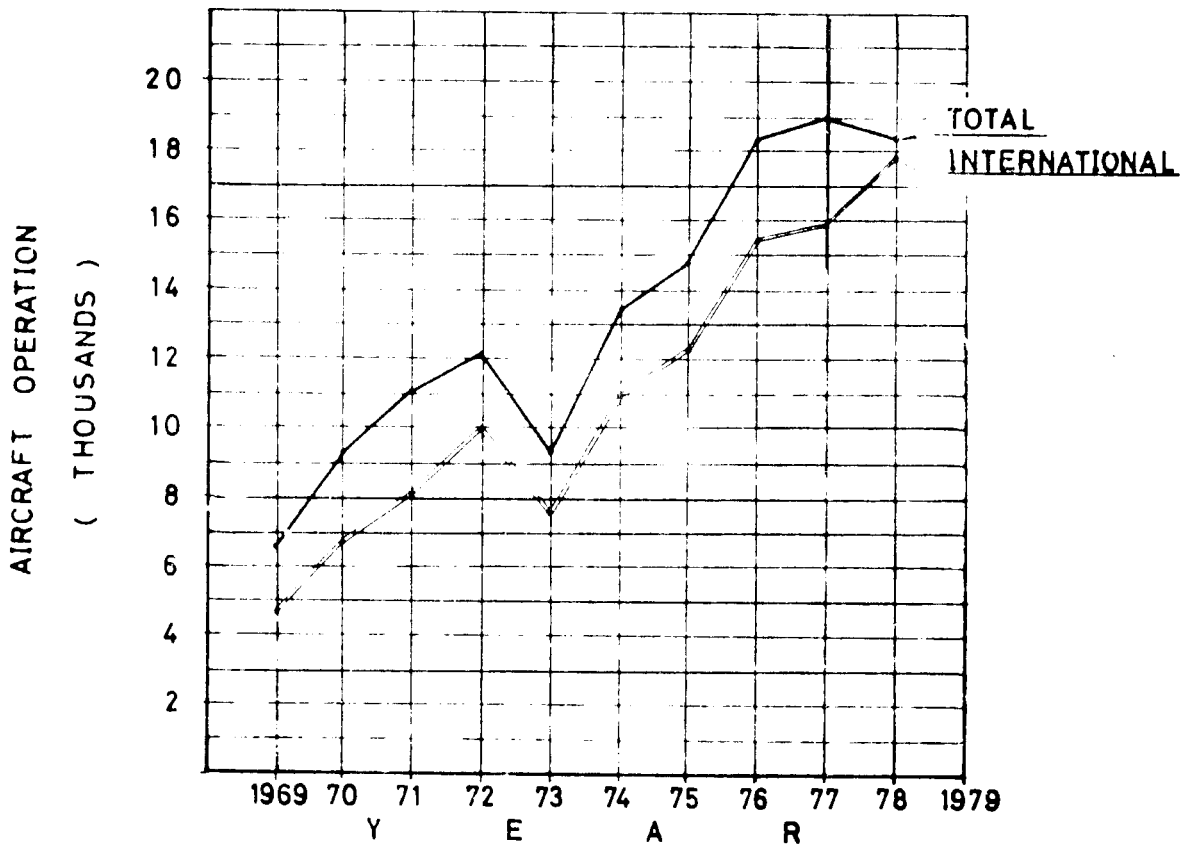
SOURCE — D G C A.

Figure A-3.1

Figure A-3.2

DAMASCUS INTERNATIONAL AIRPORT

AIRCRAFT OPERATIONS



SOURCES: TABLE A-3.2
DGCA.

While the results of the air passenger survey were available only after the passenger forecast had been developed in Phase I, an analysis of the results does not lead to any fundamental change in the forecast developed in Phase I. The results in fact reinforce the assumptions made in the Phase I forecast and tend to confirm the forecast. Most important is the relatively small proportion of tourists in the total - about 32 percent. This percentage was no doubt affected by the fact that the survey was carried out between November 1979 and March 1980, which is off the main tourist season in Syria.

The results do indicate, however, that under current circumstances business conditions will be an important determinant of air travel. On the other hand, if tourism is promoted and developed and business conditions remain relatively stable, there is substantial potential for even greater growth in air travel than has been forecast here. In developing countries where tourism is important, the tourist proportion of total travel can easily reach 60 percent of total traffic.

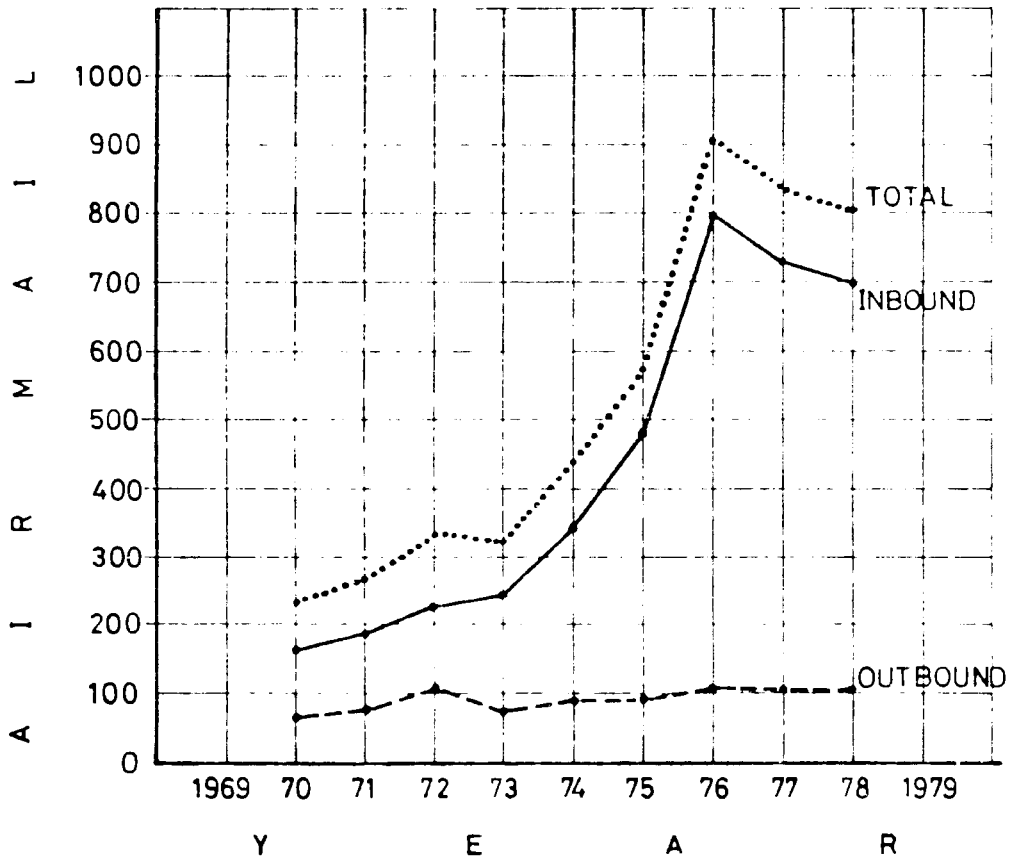
With regard to other characteristics of airline passengers, a large proportion is male (83 percent) and non-Syrian (63 percent), supporting the business orientation of the majority of travellers.

In summary, the survey results support the conclusion that until greater efforts are made to promote tourism, future international air travel will be tied to business conditions in Syria and the Middle East.

A remarkable divergence of inbound and outbound air mail occurred at Damascus during the seven-year period from 1970 to 1976, inclusive, as shown in Figure A-3.3. Almost all of the quadrupled mail tonnage was inbound mail. The greatest annual rate of growth occurred in 1976, when a 62.6 percent growth was recorded. When the growth pattern broke sharply in 1977, all the decline was in inbound mail. No detailed statistics concerning air mail classifications have been found. However, it is clear that a very large percentage of the whole comprised newspapers, periodicals, trade literature and parcels, almost all of which were sent to Syria from abroad. By reason of their heavy weight, these materials would dominate the air mail statistics. When restrictions on imports and suspension of new public capital ventures were invoked in 1977, the high value/weight ratio imports, characteristically carried by air, were sharply reduced. Also reduced was foreign language literature, much of which was associated with foreign trade or with the merchants and professionals involved in developmental activities.

DAMASCUS INTERNATIONAL AIRPORT

AIRMAIL TRENDS



YEAR	AIRMAIL (METRIC TONS)		
	IN	OUT	TOTAL
1969	——	——	——
1970	162.0	69.0	231.0
1971	186.8	77.5	264.3
1972	220.7	106.7	327.4
1973	242.7	78.1	320.8
1974	345.6	89.8	435.4
1975	475.0	94.4	569.4
1976	799.4	109.5	908.9
1977	7[illegible]6.0	107.1	8351
1978	696.2	107.8	8040
1979			

SOURCE: DGCA.

Figure A-3.3

Figure A-3.4, depicting air freight growth at Damascus International Airport, illustrates the serious problem encountered in resolving conflicts in transportation statistics. It is noted that the customs records of imports and exports by weight at Damascus International Airport bear no resemblance to the data collected by the DGCA from the air carriers. The DGCA data appear to be the more reliable; however, the discrepancies have not yet been rationalized. Early differences of the magnitude noted here require very careful investigation.

The air cargo data furnished by the DGCA is consistent with other statistics depicting aircraft operations, passenger movements, and air mail. The same characteristic break occurs in 1976-1977, and the greatest negative impact of the economic slowdown in 1977 occurred with respect to inbound air freight. There remain some puzzling relationships which require further investigation. For instance, in 1976 the inbound/outbound curves crossed. Outbound air cargo has continued to increase and inbound air cargo continues to decline. The reason for this divergence is not clear. The entire air traffic analysis is clouded by questions of data reliability.

TRAFFIC PROJECTIONS AT DAMASCUS AIRPORT

This section treats only the projections of total international passenger traffic at Damascus International Airport. This includes passenger and freight carriage by over 30 international airlines serving Syria's capital city. Projections for domestic passenger potential by city pair are given in Chapter B-4, as are projections for Syrianair international passenger movements.

As already noted, the growth of passenger movement in the preceding decade was high and erratic and markedly influenced by regional political events. It would be unwise to use the growth trends of the 1970s to project future traffic. Instead, a more realistic approach has been taken, based on Middle East regional air passenger traffic trends. Major assumptions basic to this projection are:

- relative political stability in the Middle East,

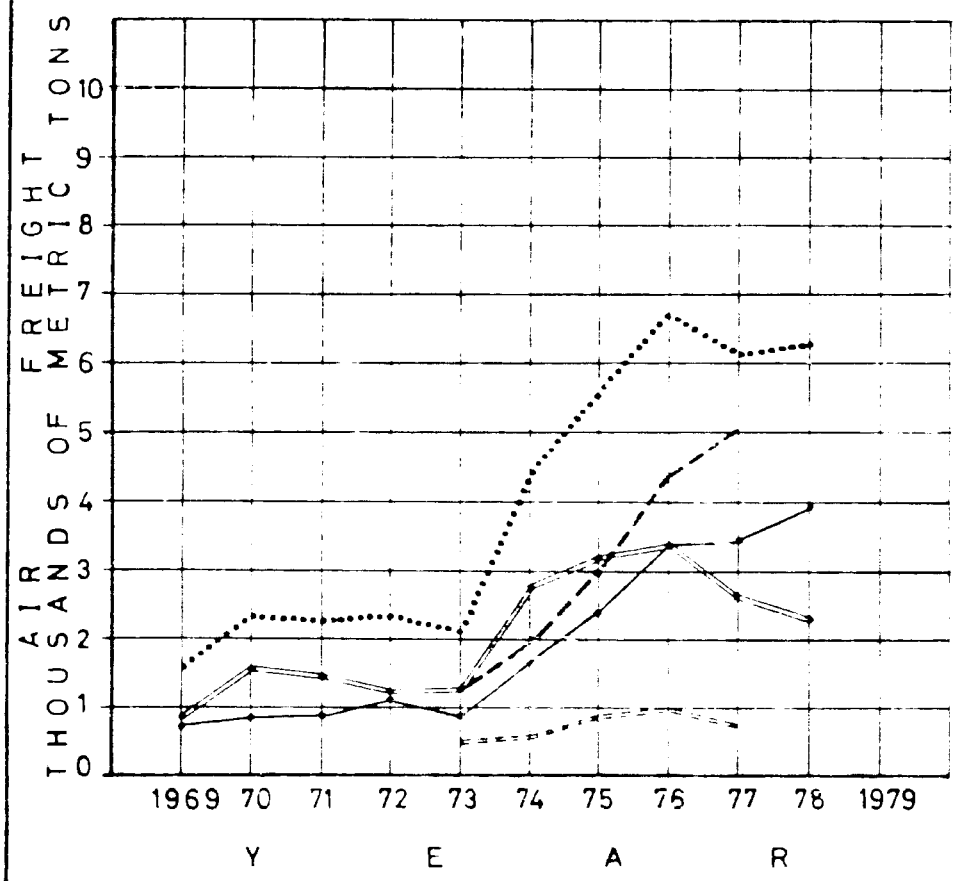
- better exploitation of Syria's outstanding tourist potential,

- improved mix of routes and aircraft types by Syrianair, as discussed in Chapter B-3, and

- efficient ground-handling services for all airlines, including markedly improved passenger handling in and out of Damascus.

DAMASCUS INTERNATIONAL AIRPORT

AIR FREIGHT MOVEMENTS



YEAR	CARGO (METRIC TONS)				
	IN	OUT	TOTAL	IMPORT	EXPORT
1969	825.3	745.4	1,570.7		
1970	1,519.0	812.5	2,331.5		
1971	1,409.8	873.2	2,283.0		
1972	1,264.9	1,080.7	2,346.6		
1973	1,247.9	883.3	2,131.2	1,271	447
1974	2,734.2	1,632.2	4,366.4	1,919	509
1975	3,165.2	2,370.7	5,536.0	2,937	881
1976	3,351.9	3,342.7	6,694.6	4,318	945
1977	2,685.4	3,412.5	6,097.9	5,017	721
1978	2,310.7	3,906.8	6,217.5	1,108*	419*
1979					

*6 Months

♠ FOREIGN COMMERCE STATISTIC—MIN. FINANCE.

• SOURCE: DGCA.

Fig. A-3.4

In 1979, based on actual movements for the first six months, some 930,000 passengers passed through the Damascus Terminal Building. This figure reflects a historic fact that because of the two Eid holidays, the Hadj and the Christmas holidays, air passenger traffic in the second half of a year makes up 60 percent of annual traffic.

To the 1979 traffic base, an average annual growth rate of 17 percent has been applied through 1985. This is the same as the average annual rate of growth of 17 percent experienced by Middle East international airports over the past decade.

It is anticipated that the 17 percent average annual growth rate will begin to taper off after 1985. A growth rate of 10 percent annually has been used for 1986-1990, dropping further to an annual rate of 6 percent between 1991 and 2000. Table A-3.1 presents total projected passenger movements at Damascus International Airport. The traffic projections are presented graphically in Figure A-3.5. Preliminary recommendations for investment projects at Damascus International Airport are based on the conservative traffic projections presented in this chapter.

Table A-3.1

DAMASCUS INTERNATIONAL TERMINAL PASSENGER PROJECTIONS TO 2000
(000)

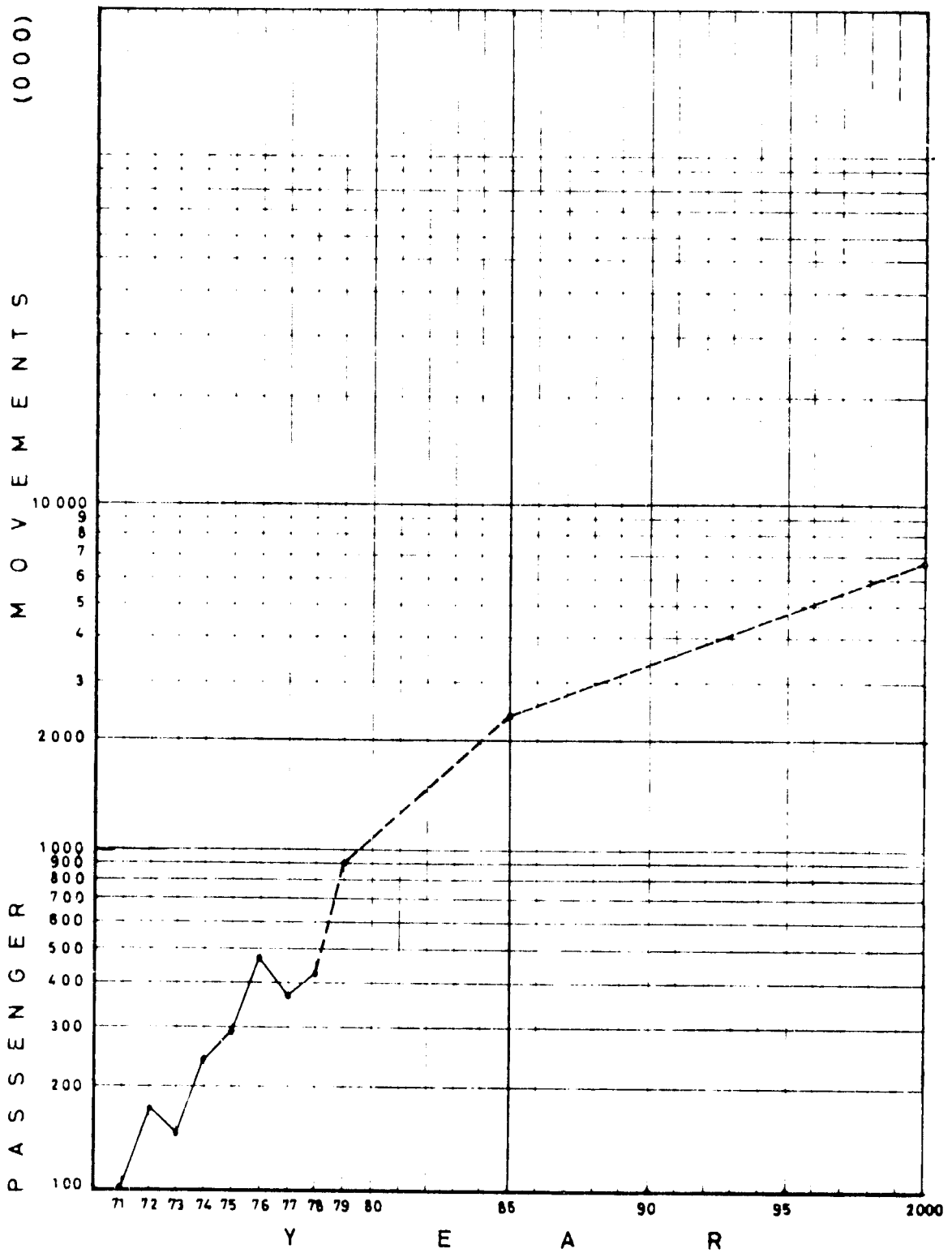
	1979	1985	2000
Passenger Movement	929	2,352	6,782

Sources: DGCA and Consultants' estimates.

Figure A-3.5

INTERNATIONAL TERMINAL PASSENGER MOVEMENTS, DAMASCUS AIRPORT, ACTUAL AND PROJECTED

(NOT INCLUDING TRANSIT)
(000)



Cargo Tonnages

The past combined cargo plus mail tonnage at Damascus Airport is given in Table A-3.2. The development of cargo tonnages has been modest during the period under review. Although the total tonnage in 1978 was almost three times the tonnage in 1970, the number of kilograms of freight per terminal passenger has varied but does not show any growth over the total period. The ratio of freight per passenger remained at the level of approximately 10 kilograms.

The ratio of 10 kilograms of freight per passenger is averaged through the 1970 decade in forecasting freight and mail volume for the target years 1985-2000.

As volume per aircraft movement is low, the suggested tonnage can easily be transported in scheduled passenger aircraft services.

The annual movement figures of all-cargo aircraft are small for applying statistical relations in order to determine peak hour movements and cargo apron stand requirements. The present plans for an apron with four stands are adequate.

As far as the dimensions of the cargo apron and cargo building are concerned, the following can be concluded:

- The building, with an average handling and storage capacity of five tons per square meter per year, should be sufficient for the target years.

- The projected apron will most probably be sufficient for the whole of the forecast period until 2000. However, it would be prudent to reserve areas for at least doubling parking capacity.

The total cargo tonnage in the year 2000 is estimated to be about four times the present tonnage.

Aircraft Movements and Passengers per Flight

The historic development of the number of aircraft movements is shown in Figure A-3.2. These are for scheduled and non-scheduled commercial traffic only. No domestic training, private or government, is included in the figures. The same figure shows average passengers per flight, including terminal and transit passengers.

Given the passenger projections presented in Figure A-3.5 the forecast for the annual number of aircraft movements is based on the average per aircraft occupancy.

Table A-3.2

INTERNATIONAL PASSENGER CARGO AND MAIL TONNAGE DEVELOPMENT

Year	Cargo and Mail Metric Tons	Aircraft Movement	Terminal Passenger Movements (000)	Freight per Flight (Kilos)	Freight per Terminal Passenger
1969	1,570.7	4,750	158.9	330	9.9
1970	2,662.5	6,700	175.4	397	15.2
1971	2,547.3	8,100	217.7	314	11.7
1972	2,674.0	9,950	252.9	269	10.6
1973	2,452.0	7,650	256.8	321	9.5
1974	4,801.8	10,900	444.2	441	10.8
1975	6,105.4	12,205	599.2	498	10.2
1976	7,603.5	15,650	920.9	468	8.3
1977	6,933.0	15,850	771.6	437	9.0
1978	7,021.5	17,750	929.4	396	7.6
Forecast Period					
1985			2,350.0		10.0
1990			3,500.0		10.0
2000			3,800.0		10.0

Source: Directorate General of Civil Aviation and Consultants' estimates.

Experience shows that increased passenger traffic generates higher frequencies of aircraft operations as well as the use of aircraft with higher capacities and with more passengers per flight. It is assumed that both frequencies of aircraft movements and passengers per flight will show similar rates of increase.

The relation between the number of passengers per flight and the number of aircraft movements is shown graphically in Figure A-3.6. From this figure the future relation between these two components can be derived. Each point on the line is associated with a total yearly number of passengers, indicated by angled lines. The indicated number of passengers is the sum of the number of terminal passengers and twice the number of transit passengers; the latter figure is fixed at 17 percent of terminal passengers.

Table A-3.3 presents the following information for the years 1969-1979 and projections for 1985 and 2000:

- total number of terminal passenger movements as calculated together with the number of transit passengers,

- total number of passengers per flight,

- number of aircraft movements, and

- average seating capacity of aircraft calculated from the number of passengers per flight.

Figure A-3.7 shows projections of aircraft movements through 2000.

From the total number of passengers per flight, the number of terminal passenger movements as well as the number of transit passenger movements per flight have been calculated assuming a stationary percentage of transit passengers throughout the period.

Aircraft Type Mix

The mix of aircraft types will change between now and 2000, as shown in Table A-3.4. Aircraft with higher capacities will replace smaller types to cope with increased passenger demand. Present investigations show that 53 percent of the present aircraft movements are performed by short- to medium-range aircraft types, such as Caravelle, DC-9, and TU 34, with seating capacities of 80-150 seats. Thirty-six percent of present aircraft movement is performed by medium- to long-range aircraft types like the VC-10, DC-8 or B 707, with seating capacities of 130-200 seats.

Figure A-3.6

RELATION BETWEEN THE ANNUAL PASSENGER - AIRCRAFT MOVEMENT AND THE NUMBER OF SEATS OCCUPIED

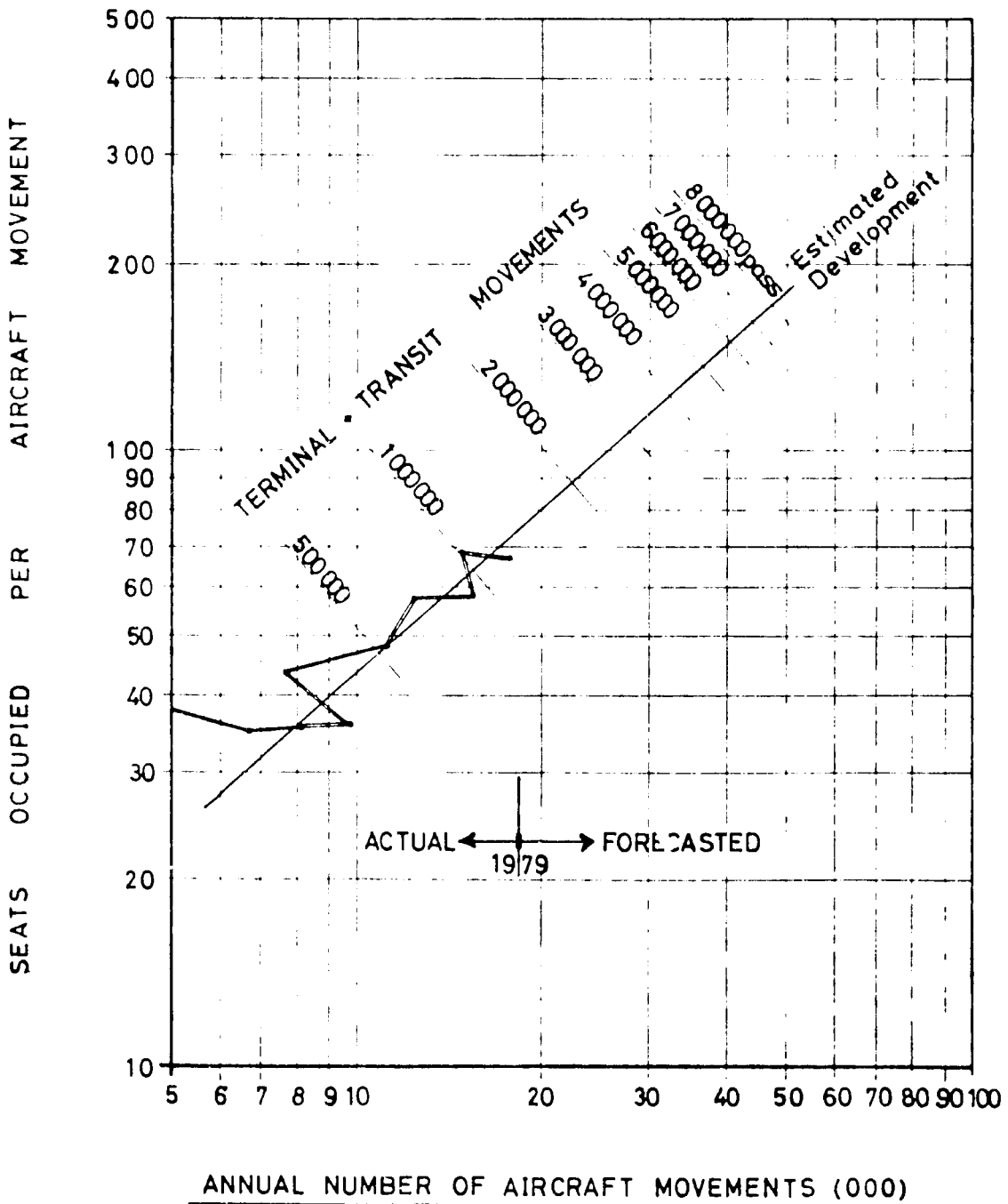


Table A-3.3

COMMERCIAL AIRCRAFT MOVEMENTS AND PASSENGERS PER FLIGHT

Year	International[1] Aircraft Movements	International Terminal Passenger Movements (000)	Transit Passenger Movements (000)	Total International[2] Passengers per Flight (including transit)	Average[3] Seating Capacity
1969	4,750	158.9	26.3	39.0	65
1970	6,700	175.4	55.6	34.5	58
1971	8,100	217.7	64.4	35.0	58
1972	9,950	252.9	95.1	35.0	58
1973	7,650	256.8	67.8	42.4	71
1974	10,900	444.2	82.5	48.3	84
1975	12,205	599.2	102.6	57.5	96
1976	15,650	920.9	126.9	66.8	111
1977	15,850	771.6	147.2	58.1	97
1978	17,750	929.4	127.7	68.6	114
Forecast Period					
1985	27,000	2,350	400	105	175
1990	34,500	3,800	650	132	220
2000	46,500	6,800	1,115	168	280

Source: Directorate General of Civil Aviation and Consultants' estimates.

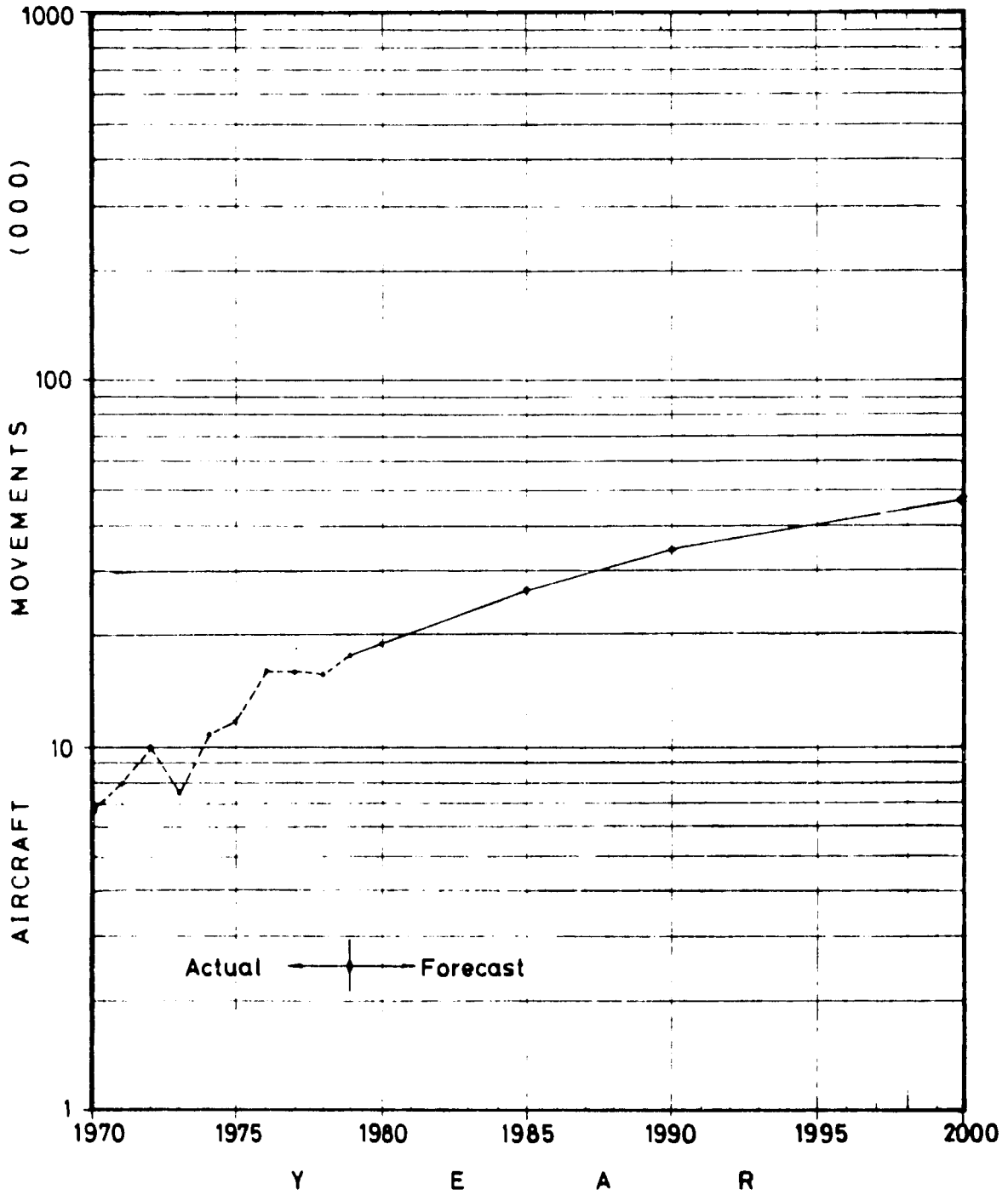
1 Assuming equal rates of increase for:
a. number of passengers per flight
b. number of aircraft movements

2 Number of international terminal passengers added to the number of transit passenger movements.

3 Based on 60 percent load factor for total number of passengers per flight.

Figure A-3.7

DEVELOPMENT OF COMMERCIAL AIRCRAFT TRAFFIC



EXCLUDING DOMESTIC, TRAINING, PRIVATE, AND GOVERNMENT TRAFFIC

Table A-3.4

PERCENTAGE DISTRIBUTION OF AIRCRAFT TYPES, 1979-2000

Short to Medium Range Types	Seating Capacity	Percentage Distribution 1979	1985	1990	2000
BAC-111 B737 B727 TU-34	80-150	53	42	35	20
DC-X-200 B-7-X-7 A300	175-200	3	10	15	25
Med. to Long Range Types					
VC-10 B-707 DC-8-50/60	130-200	36	30	20	10
L-1011 DC-10 B 747 SP	250-300	7	15	25	30
B-747 L-1011 str. DC-10 str.	350-400	1	3	5	10
B-747 str Future Types	500+	-	-	0	5
Average Capacity		113	160	220	270

Sources: Airline Guide and Consultants' estimates.

Note: 1979 distribution according to the analysis of present airport time table data.

These older-generation jet aircraft will gradually be replaced during the next five to ten years by aircraft with capacities of between 175 and 300 seats. Already existing types are: L-1011, DC-10 and A 300, all in the range of 250-300 seats. Possible new types are the DC-X-200 and the B-7-X-7, with 175 to 200 seats. Increased use will be made of the B 747, with approximately 370 seats.

The new types will also be used on short to medium ranges as replacements for existing aircraft types (BAC-111, B 737, DC-9).

Even larger capacities can be expected, peaking during the 1985-2000 period, namely:

- stretched versions of the L-1011 and the DC-10 with capacities in the order of 350 to 400 seats, and

- stretched B 747 types with at least 500 seats.

The introduction of a superjumbo with considerably higher capacity is not considered very likely before the end of the planning period.

The basic idea is that with the present rate of world traffic growth, stretched versions having approximately 4 percent higher capacities will come into use approximately ten years after the operational readiness of the original type. Completely new types, doubling the capacities, are developed within approximately 20-year intervals.

A tentative distribution of aircraft types has been determined, based on:

- passenger traffic forecast,

- average seating capacity,

- aircraft movement development, and

- growth projections for passenger aircraft.

Peaks in Aircraft Movements

The airport tower log book data were analyzed, and the results are in Table A-3.5. Hourly peaks on scheduled aircraft move--ents (departures and arrivals) were derived for consecutive 60-minute periods.

Peak apron stand requirements, that is, the maximum number of parking stands simultaneously in use, were determined. This includes stands for night stops when required.

Table A-3.5

ANALYSIS OF AIRPORT TOWER LOGBOOK DATA

1978	Aircraft Movements		Peak Day Movements		Peak Day Movements		Peak Hour Movements						Apron Pushing Stands Occupied	
							Int.			Others				
	Int.	Others	Int.	Others	Ratio Int.	Ratio Others	Mov	Arr	Dep	Mov	Arr	Dep	Int.	Others
Jan.	1,066	210	43	14	1.25	2.07	7	4	5	3	2	1	7	2
Feb.	963	169	49	12	1.42	1.99	6	4	4	2	1	2	6	3
Mar.	1,204	207	52	20	1.34	3.00	7	5	4	4	3	1	7	4
Apr.	1,243	263	56	18	1.35	2.05	8	5	5	3	2	1	7	3
May	1,138	221	49	16	1.33	2.24	8	5	6	3	3	1	7	2
June	1,180	210	50	17	1.27	2.43	7	6	4	3	2	1	8	3

Note: Int. = International; Mov.=Moving; Arr.= Arriving; Dep. = Departing.

Table A-3.6

PEAKS ON AIRCRAFT MOVEMENTS AND AIRCRAFT PARKING STAND REQUIREMENTS

Year	Annual Movements Intern.	Annual Movements Others[1]	Peak Day Movements Intern.	Peak Day Movements Others	Peak Hours Movements Intern.	Peak Hours Movements Others	Parking Stands Intern.	Parking Stands Others
1985	27,000	5,400	92	30	13	5	10	4
1990	34,500	6,900	118	38	16	6	13	5
2000	46,500	9,300	15	51	20	8	16	6

Source: Airport logbook.

1 Traffic other than international commercial traffic estimated at 20 percent of the latter.

In planning the apron stand use and in allocating gates, some margin should be allowed for normal deviations from the official time schedule. The minimum margin between two aircraft making use of the same parking stand is estimated to be 15 minutes.

The various relations that follow from the analyses are average for the type of traffic at the Damascus Airport and are suitable for forecast purposes. These relations are:

- Peak day international traffic proved to be just over 1.3 times and other traffic 2.3 times the average day traffic intensity.

- Arrivals or departures were equal to approximately 70 percent of the peak hour (60-minute) movement number.

- Average parking time schedule is:

short- to medium-range aircraft (25% mov.)	45 minutes
long-range aircraft types (75% mov.)	75 minutes
average parking time (total traffic)	67.5 minutes

The peak number of arrivals or departures averages 70 percent of the total movements. This results in a required number of aircraft parking stands of $\frac{67.5}{60} \times 70\%$ = about 80 percent of the number of hourly movements. It should be noted that due to delays, additional flights, or other conditions, extreme peaks may occur, requiring additional parking stands. The necessary reserve is taken at 25 percent of the normal peak demand.

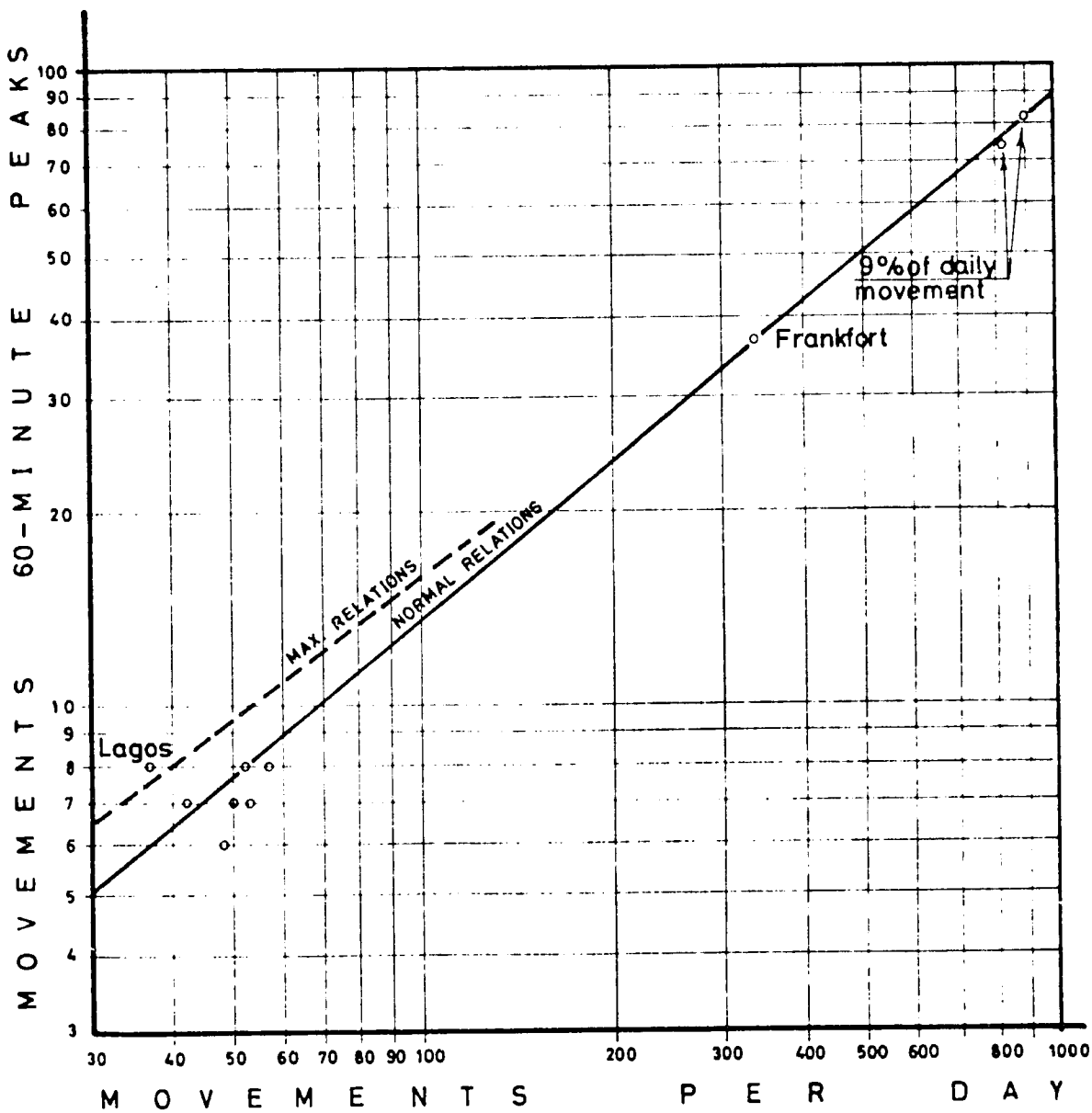
For the calculation of future peaks on aircraft movements, it has been assumed that in the future the peak-month scheduled traffic will count for 9 percent of the annual scheduled traffic, while the ratio between the number of peak day aircraft movements and average day aircraft movements will decrease to 1.25. This results in peak-day scheduled aircraft movements of 9 x 1.25:31 = .36% of the number of annual scheduled aircraft movements.

The annual aircraft movements and the peak day aircraft movements have been shown in Table A-3.6 for all traffic.

There is a variable relation between the number of daily aircraft movements and the number of peak hour movements. Peak hour traffic as a percentage of the daily traffic tends to decrease gradually as the latter grows in volume. The relation between the number of peak day movements and the number of peak hour movements is shown graphically in Figure A-3.8.

Figure A-3.8

RELATION BETWEEN PEAK-DAY AND PEAK-HOUR AIRCRAFT MOVEMENT



These data for Damascus are similar to those for other international airports.

From the figure, it can be concluded that:

- The present percentage is on the order of 15.

- The percentage will decrease gradually to approximately 9 percent at the time of runway saturation.

The number of peak hour aircraft movements are calculated accordingly and are included in Table A-3.7 for international as well as other traffic.

For the calculation of the number of parking stands required, it is assumed that the average parking time in the future will be of the same duration as at present. This assumption is realistic because of the increase of aircraft sizes, even though aircraft servicing will be more mechanized. The number of parking stands around the building amounts to 80 percent of the number of peak hour passenger aircraft movements for aircraft type distribution as well as total parking stand requirements. These figures are given in Table A-3.6. The required number of aircraft parking stands include stands for B 747 or larger types.

As a rule, parking stands should have direct connections with building gates. In addition to the close-in stands, remote (reserve) stands are needed to cover extreme peak demands. The extra number of stands should be about 20 to 25 percent of the normal peak hour close-in stands. This requirement calls for two or three stands in 1985, gradually increasing to four or five stands in the year 2000. Bus gate facilities will be required to serve the remote stands.

The peaks for international traffic can be expected to occur at least once per week throughout the year. The peaks on other traffic are less frequent and are irregular.

Peaks in Passenger Movements

The peaks in passenger movements are calculated for a 60-minute period. The total number of arriving and departing passengers is simply the product of peak hour aircraft movements and the average number of terminal passengers per flight. According to experience, the annual average load factor should be multiplied by a factor 1.25 to cover peaks.

The number of peak hour passengers arriving or departing is calculated on the basis of the total number of terminal passengers considering that:

Table A-3.7

PEAKS FOR PASSENGER TRAFFIC AT A PEAK TERMINAL PERIOD

	Aircraft Movement		Terminal[1] Pass. per Flight		Terminal Passengers		Arrival or Departure[2] Passengers	
Year	Intern.	Domestic	Intern.	Domestic	Intern.	Domestic	Intern.	Domestic
1985	13	4	110	30	1,450	120	1,100	90
1990	16	4	140	30	2,250	120	1,700	90
2000	20	4	170	30	3,600		2,700	90

Note: The totals of arriving and departing passengers should be increased by 17 percent for transit passengers. These passengers will not leave the aircraft unless on-ground time is more than 45 minutes.

Intern. = International.

[1] Estimated to be 1.25 times the annual average.

[2] Arriving and departing peaks in the peak month, average load factor 1.3 times the annual average.

Arriving or departing passengers 70% x (1.3): 1.25 = approximately 75 percent of the peak-hour passenger movements.

- Aircraft arrivals or departures equal 70 percent of the peak hour movements.

- Arrival and departure peaks show a load factor of 1.30 times the average load factor.

This means that the peaks for arriving or departing passengers are $0.70 \times \frac{(1.30)}{1.25}$ = approximately 75 percent of the peak hour passenger movements. The totals of arriving or departing passengers should be increased by 17 percent for transit to allow for transit passengers. These passengers are expected to leave the aircraft only in case of traffic stops over 45 minutes.

Transit passengers are of no consequence in terms of the handling-capacity of the building.

Peaks in car movements and car parking stand requirements will coincide with the peak hour passenger traffic.

Projections are made (on basis of the projected peak hour terminal passengers) for:

- the number of car movements (one-directional),
- the number of car parking stands, and
- the number of taxi stands.

The number of car movements in the peak hour is calculated on the assumption that 20 percent of the passengers travel by bus and that the remaining passengers travel at a rate of two passengers per car (private car or taxi). The figures are given in Table A-3.8.

To find the required capacities of the access road, the total car movements (one directional) should be increased by approximately 25 percent to cover personnel and service traffic.

As an access road, a 4-lane dual carriageway (2 x 2 lanes) should be sufficient until the year 2000.

The required number of short-term car parking stands during the peak hours is calculated on the basis of the following assumptions:

- 50 percent of the car movements are by private car, of which 90 percent require a parking stand for a period 30 to 45 minutes.

Table A-3.8

PEAK ON AUTOMOBILE MOVEMENTS AND PARKING STAND REQUIREMENTS

(Peak 60 minute period)

Year	Terminal Passengers	Car Movements[1]	Car Parking[2] Stands	Taxi[3] Stands
1985	1,570	625	925	110
1990	2,370	950	1,450	165
2000	3,770	1,500	2,550	260

1 At the rate of two passengers per car (private or taxi), the total of car movements should be increased by approximately 25 percent for personnel and service traffic. Twenty percent of passengers travel by bus.

2 Based on the summation of:

- Peak hour parking, 50 percent of the car movements by private cars, 90 percent of these parking (arrival peak) average parkin time 30 to 45 minutes, in which time 75 percent of the hourly traffic, viz. (number of car movements) x 50% x 75% x 90% approximately 35 % (car movements);

- Five to ten percent of the passengers leaving their cars at the airport for the duration of their journey need approximately 300 car stands per million of annual terminal passengers.

3 Based on 50 percent of the car movements by taxi and an average waiting time at the airport of 20 minutes, approximately 70 taxi stands should be provided per 1000 peak hour terminal passengers.

- In the period of 30 to 45 minutes, 75 percent of the hourly traffic may be expected.

The number of short-term car parking stands required during the peak hours amounts to:

(0.5 x 0.75) (.90) = approximately 35 percent of the number of car movements. To this figure should be added the long-term car parking stands required for the 5 to 10 percent of the passengers who want to leave their cars at the airport for the duration of their journey. This consideration requires approximately 300 car stands per million of annual terminal passengers.

Parking space required by passengers leaving their car at the airport can be provided at some distance from the terminal with frequent bus connections.

The number of taxi stands is based on the following:

- 50 percent of car movements are taxis.

- Average waiting time at the airport is 20 minutes.

The requirement for taxi stands is calculated to be 70 per 1,000 peak hour terminal passengers.

Table A-3.9

INTERNATIONAL AIR PASSENGER SURVEY

Table 3.9a Origin or Destination in Syria of International Air Passenger

Location	Arriving Passengers	Departing Passengers	Total
Damascus	324	467	791
Aleppo	37	51	88
Lattakia	28	17	45
Homs	11	22	33
Hama	4	6	10
Tartous	11	10	21
Deir Ez Zor	1	4	5
Zabadani	3	5	8
Dera'a	0	2	2
Al Kamishli	2	4	6
Idleb	0	2	2
Transit	72	14	86
Total	493	604	1,097

Table 3.9b Mode of Travel to and from Damascus

	Road	Air	Total
Arriving Passengers	436	41	477
Departing Passengers	525	18	543
Total	961	59	1,020

Table A-3.9 (Continued)

INTERNATIONAL AIR PASSENGER SURVEY

Table 3.9c Trip Purpose of International Air Passengers

Airline	Work	%	Tourist	%	Other	%	Total
Syrianair	231	60	95	25	59	15	385
British Air	36	55	20	31	9	14	65
S A S	144	69	48	23	17	8	209
Alitalia	87	46	88	47	13	7	188
Cyprus Air	137	55	99	40	14	5	250
Total	635	58	350	32	112	10	1,097

Table 3.9d Nationality and Sex of International Airline Passengers

	Syrian	Non Syrian	Total	Male	Female	Total
Syrianair	198	194	392	334	64	398
British Air	26	40	66	56	12	68
S A S	40	158	198	175	33	208
Alitalia	98	91	189	154	37	191
Cyprus Air	43	200	243	175	33	208
Total	405	683	1,088	894	179	1,073

Table A-3.9 (Continued)

INTERNATIONAL AIR PASSENGER SURVEY

Table 3.9e Age Characteristics of International Airline Passengers

Age Group	Number	Percent
0-10	0	0
11-21	71	6.5
21-30	377	34.6
31-40	297	27.3
41-50	228	20.9
51-60	95	8.7
61-70	22	2.0
71+	0	0
Total	1090	100.0

Table 3.9f Occupational Characteristics of International Airline Passengers

Occupation	Number	% of Respondents
Commerce	235	25.9
Administration	91	10.0
Managerial	49	5.4
Government	42	4.6
Engineering	151	16.6
Student	57	6.3
Mechanic	51	5.6
Dependent	57	6.3
Laborer	107	11.8
Transportation	29	3.2
Literature	11	1.2
Medicine	29	3.2
Total	909	100.0

Table A-3.9 (Continued)

INTERNATIONAL AIR PASSENGER SURVEY

Table 3.9q Characteristics of International Passengers
Employers and Ticket Payment

	Employer		Payment of Ticket	
	Number	Percent	Number	Percent
Private Company	471	54.1	261	27.0
Government	165	18.9	79	8.2
Self	-	-	542	56.0
Others	235	27.0	85	8.8
Total	871	100.0	967	100.0

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CHAPTER A-4

AIR NAVIGATION SYSTEM

Chapter A-4

AIR NAVIGATION SYSTEM

INTRODUCTION

The Phase I Report described and analyzed Syria's existing air navigation system. That Report also identified the needs for better maintenance and improvement of the navigation system.

This chapter presents the final findings and recommendations, including an investment schedule.

RECOMMENDATIONS

FIR Geometry

At present, Damascus FIR consists of the airspace over the territories of the Syrian Arab Republic, including a 12 nautical mile wide strip along the coast. Damascus FIR is surrounded by a number of relatively small FIRs, such as Nicosia FIR, Beirut FIR, Amman FIR, and Baghdad FIR. For modern jet aircraft, the size of these FIRs is too small to be operationally convenient and efficient, especially for the pilot but also for the air traffic controller. Overflying Syria from Beirut to Amman or Baghdad, the aircrafts stay for less than 20 minutes within Damascus FIR.

The frequent transfer from one FIR to another is inefficient and increases the risk of misunderstandings and misinterpretations because of coordination problems.

Steps should be taken through negotiations with neighboring countries towards a reduction in the number of FIRs in the area. These negotiations could take a considerable period of time. Even more time consuming may be the Consultants' recommendation to integrated upper-space control in the region, with participation by Syria, Jordan, and Iraq. For safety, aircraft overflying the region should be controlled by one centralized supranational high-altitude ATCC. Although the Consultants are aware of the problems faced by such integration, they consider this plan worth implementation since it could offer a substantial contribution to efficiency and safety for air traffic over the region.

Airways

The geometry of the present airway system over Syria has a history. Beacons were initially installed at certain locations. Later changes in infrastructure and the airways network were not followed by a relocation of beacons. A clear example is the airway from Damascus to Al Quaryatein, which starts from a beacon located at Mezzeh because the Damascus Airport was originally located in Mezzeh. After the relocation of Damascus Airport to the present site, the beacon remained at Mezzeh, even though it serves as the initial point for the airway itself. There is no operational reason for leaving this beacon as a starting point for airway A 21.

Another example is the existence of a reporting point in airway DW 5 over the former civil airport of Al Jabbal. This results in an inefficient airway geometry.

As is pointed out in Chapter B-3, the present airway system geometry is hampering air traffic efficiency, especially domestic traffic. Airway kilometers are sometimes considerably in excess of distances as the crow flies and are even longer than road distances. This adds to the airline operator's operating costs and increases travel time.

In view of the recommendation for a completely new operation for the domestic network, the Consultants firmly recommend the straightening of a number of airways in the Syrian system. This proposal requires negotiations with the military to reallocate the airspace over Syria. The existing and proposed air systems are shown in Plates A-4.1 and A-4.2.

The changes in the system are:

- a straight airway Damascus to Aleppo, with a starting point at Damascus VOR instead of Mezzeh NDB,
- a new airway Damascus VOR - Palmyra-Deir Ez Zor,
- a straight airway Aleppo - Al Hassakeh,
- a new airway Banias -Deir Ez Zor -Baghdad,
- a new airway Damascus Amman,
- a new airway Aleppo - Adana (Turkey),
- a new airway Aleppo -Gaziantep (Turkey),
- a new airway Kamishli -(Turkey),
- relocation of airway R 55.

The first three airways are of importance to the domestic network and are therefore most urgently needed. The others are for international connections and for aircraft overflying Syrian territory.

The width of the airways is 10 nautical miles. It is recommended to decrease the lower limit of a number of airways to enable the turbopropellar aircraft to fly at economic cruising altitudes on these relatively short ranges. Flight level 150 might be an acceptable lower limit.

The ICAO air navigation plan for the Middle East and Southeast Asia lists as recommended facilities in Syria the following airways:

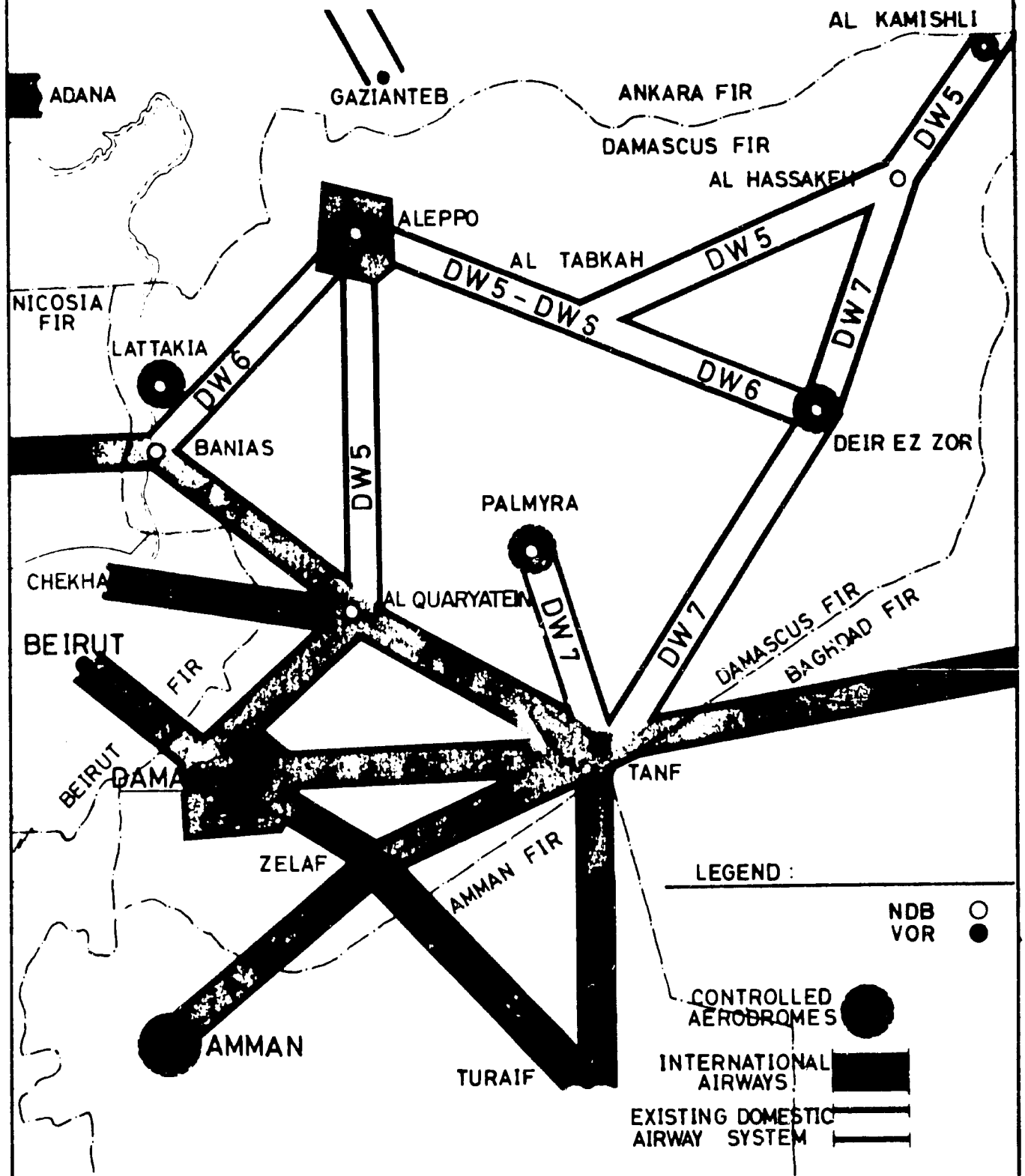
- G 55 Baghdad, Deir Ez Zor, Aleppo, Mut (Turkey)
- R 55 Damascus, Al Quaryatein
- A 52 Damascus, Amman.

Except for part of R 55, Banias-Mut, all these airways are included in the proposed new system.

Navigation Aids

With the changes in the airway system, a number of relocations of air navigation facilities will be required.

Plate A-4.1



EXISTING AIRWAYS SYSTEM

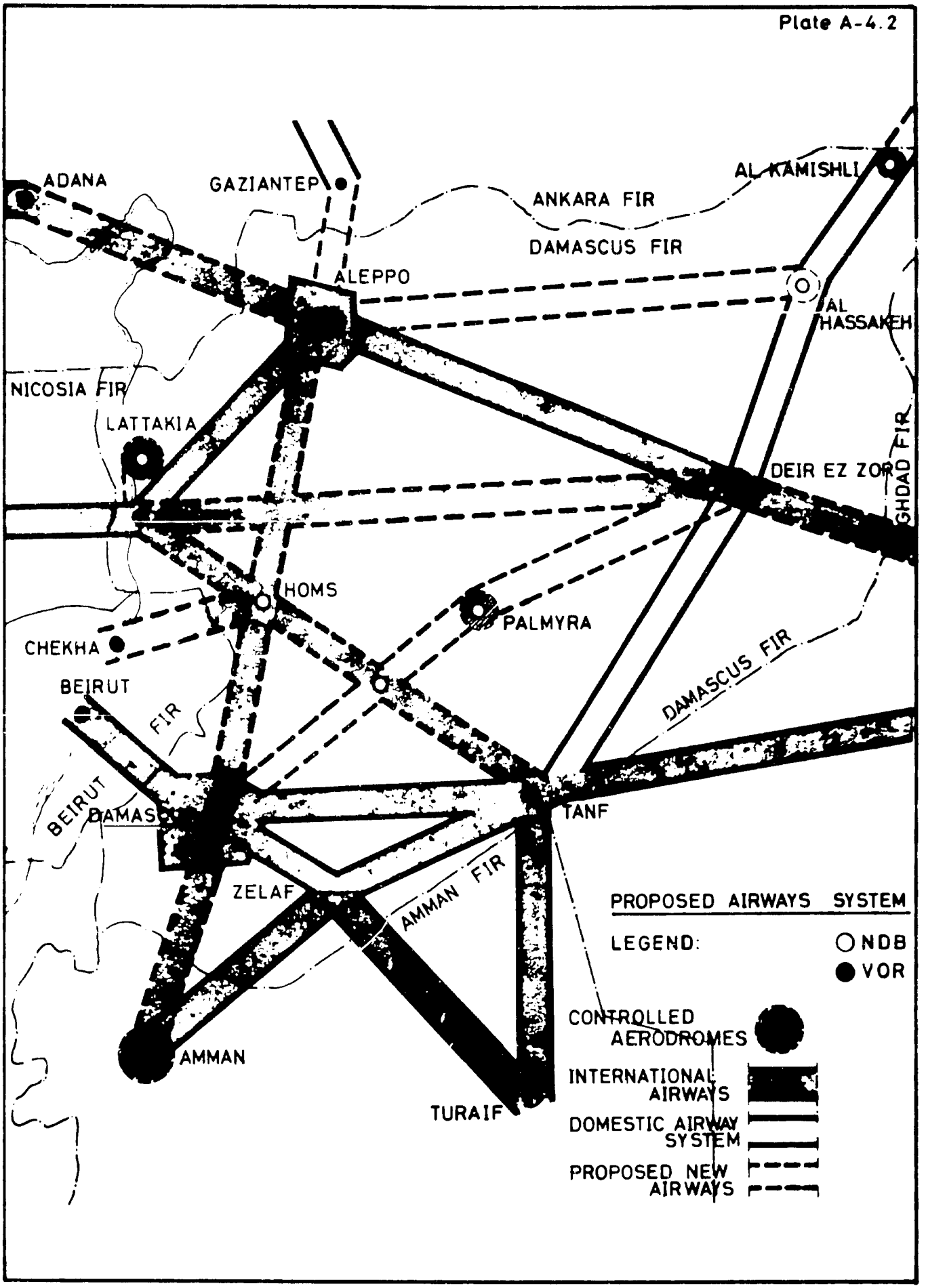


Plate A-4.2
ADANA
GAZIANTEP
ANKARA FIR
AL KAMISHLI
DAMASCUS FIR
ALEPPO
AL HASSAKEH
NICOSIA FIR
LATTAKIA
DEIR EZ ZOR
GHDAD FIR
HOMS
PALMYRA
CHEKHA
BEIRUT
FIR
DAMASCUS FIR
BEIRUT
DAMAS
TANF
ZELAF
AMMAN FIR
PROPOSED AIRWAYS SYSTEM
LEGEND:
NDB
VOR
CONTROLLED AERODROMES
INTERNATIONAL AIRWAYS
DOMESTIC AIRWAY SYSTEM
PROPOSED NEW AIRWAYS
AMMAN
TURAIF

Mezzeh NDB and Al Quaryatein NDB will not serve any function in the new system. While the DDB at Mezzeh may be needed as a beacon for in- and outbound instrument routes for Damascus International Airport (a low-powered NDB would suffice), the Al Quaryatein beacon does not have any function and should be relocated at another site.

One new beacon is required - an NDB near Homs - on the crossing of the airways of Banias-Tanf and Damascus-Aleppo. The NDBs at Banias, Deir Ez Zor, and Aleppo should be replaced by VORs, preferably colocated with a DME. The three replaced NDBs should be relocated at Palmyra, Al Kamishli, and Damascus (ADB), while the new Al Quaryatein beacon should be relocated near Homs. This relocation plan is based on the assumption that Damascus VOR and Tanf VOR will be replaced by modern equipment shortly. Standard instrument arrival procedures for Damascus International Airport should be extended and more clearly established.

The ICAO air navigation plan 1977 for the Middle East and Southeast Asia recommends a VOR at Aleppo. This is included in the above paragraph.

Aerodrome Control Zone

An aerodrome control zone should be established at Palmyra Airport, where none now exists.

Air-Ground Communications

Some upgrading of the ATCC communication system will be required, and after 1985 the equipment should be replaced gradually by more sophisticated equipment.

The existing VDF should be made operational. Traffic within the Aleppo Terminal Control Zone should be controlled by Aleppo; this will require air-ground communication equipment.

Air Traffic Surveillance

The existing primary radar system should be replaced by a modern long-range en route surveillance radar, with a range up to 200 nautical miles, with transponder capability and aircraft identification, altitude read out, and mapping capability. The automated system should preferably be operated by DGCA. DGCA should have access to all controls such as gain, range resolution MTI, and map overlays.

The possible location for this equipment should be studied in order to obtain maximum coverage of the airspace.

Aeronautical Fixed Services

A new MF radio telephone connection with Palmyra should be established for domestic use and with Jeddah for international use. Landline telephone connections with European destinations are revised. ATS direct speech circuits with Baghdad and Cairo should be installed.

Landline or MF duplex teletypewriter connections with all domestic airports need to be installed. At present, only a landline connection with Aleppo exists, but to make the new setup for domestic services efficient, Lattakia, Al Kamishli, Deir Ez Zor, and Palmyra should be included in the system. Connections are required not only with Damascus but also between the domestic airports.

A number of these connections are recommended by the ICAO 1977 Air Navigation Plan for the Middle East and Southeast Asia.

Existing teletypewriter equipment must be replaced gradually by more sophisticated and automated equipment.

Preliminary Investment Recommendations

Table A-4.1 lists equipment required to maintain and improve the air navigation system through 1985. The costs include purchase price, installation costs, and import duties.

Table A-4.1

INVESTMENT SCHEDULE, AIR NAVIGATION SYSTEM THROUGH 1985
(1980 prices SP)

	Equipment Cost (000)	Installation Cost (000)	Import Duties (000)	Total Cost (000)
1 VOR/DME[1]	1,200	300	360	1,860
2 DME[1]	1,000	250	300	1,550
Power Supply	500	150	150	800
1 Long-Range Surveillance Radar and Power Supply	87,000	1500	3000	91,500
Aeronautical Fixed Services	3,000	500	900	4,400
Miscellaneous	NR	NR	NR	890
Contingencies 25%	NR	NR	NR	5,875
Total				106,875

Note: NR = Not Relevant.

[1] This assumes that 4 VORs and 2 DMEs are in order.

CHAPTER A-5

DAMASCUS INTERNATIONAL AIRPORT AND OTHER AIRPORTS

Chapter A-5

DAMASCUS INTERNATIONAL AIRPORT AND OTHER AIRPORTS

INTRODUCTION

The Final Phase I Report contains detailed descriptions and analyses of the physical and operational characteristics of Damascus International Airport and other airports in the country. Preliminary findings and recommendations concerning these airports were also presented in that report (Volume VI, Chapters A-6 to A-10).

Based on comments from the Government, and additional technical investigation by the Consultants during Phase II of the study, these findings and recommendations were reviewed and finalized. The ensuing section of this report presents the final findings and recommendations for each of these airports.

A-5.1 DAMASCUS INTERNATIONAL AIRPORT

Recommendations

General

The recommendations that follow are based on the traffic projections given in Chapter A-3. The facilities are tailored to the required capacities for the years 1985 and 2000.

It is not possible to indicate the exact year when facilities will be required in the period from 1985 to 2000. However, facilities should always be adequate to cope with traffic flow. An early decision should be made for an update of the 1965 master plan.

Pavements

Introduction of the proposed turbopropellor aircraft on the domestic network would not have any bearing on the aircraft pavements. The largest aircraft fitting into the recommended change in aircraft types is the F-27. Such an aircraft requires an LCN of only 17 on the rigid pavements, which is far below the pavement LCN.

Table A-5.1 shows for a number of aircraft types the maximum possible take-off weights and maximum flight ranges for maximum structural payload (all cargo flights) and for space-limited payload (passenger flights) on the 3,600 meter long runway, under no wind and 15A and 25°C conditions The listed flight ranges show that most aircraft types would be able to fly nonstop to most of the important destinations in Western Europe, Eastern Europe, the Middle East, and the Far East.

A list of flight distances is shown in Table A-5.2.

For Damascus International Airport, long-haul flights originating in Damascus are feasible. The B 747 SP, for example, is able to takeoff from Damascus for a nonstop passenger flight to New York, while all other large aircraft types can fly nonstop to London. This indicates that the runway 05R-23L is long enough for any existing aircraft type.

To determine requirements for possible runway extensions in the long term, Table A-5.3 has been prepared. The table gives the required runway lengths for specific aircraft at maximum takeoff weight.

Table A-5.1

MAXIMUM ALLOWABLE AIRCRAFT TAKE - OFF WEIGHT AND MAXIMUM FLIGHT RANGES

(runway length 3600 under 15A and 25°C conditions)

Aircraft Type (Engine Type)		Maximum Allowed T.O.W. (lbs)	Maximum Possible Flight Range (Nautical Miles)	
			Cargo	Passengers
B747-100	(JT9D - 7A)	715,000	2,650	4,650
B747-200B	(JT9D - 70)	790,000	4,100	5,500
B747SP	(JT9D - 7A)	660,000	4,900	5,800
B727-200	(JT8 - 17)	197,000	1,800	2,300
B707-320B	(JT3D - 3B)	325,000	4,200	4,850
DC-8-55		308,000	3,850	4,150
DC-8-63		320,000	2,300	2,900
L-1011-200		466,000	3,250	2,750
DC-10-30		517,000	2,800	3,300
A300B4		330,000	1,300	2,250
DC-9-30		107,000	900	1,400
B737-200	(JT8D - 9)	111,000	550	1,450
B757-200		230,000	1,600	2,500
B767-200		282,000	950	1,850

Source: Manufacturers' specifications.

Table A-5.2

FLIGHT DISTANCES FROM DAMASCUS

Destination	Distance in Kilometers	Distance in Nautical Miles
BEIRUT	106	57
PALMYRA	233	126
LATTAKIA	283	153
LARNACA	311	168
ALEPPO	324	175
DEIR EZ ZOR	398	215
KAMISHLI	617	333
BAGHDAD	718	388
MEDINA	1,035	559
ISTANBUL	1,081	584
KUWAIT	1,184	639
ATHENS	1,259	680
JEDDAH	1,352	730
TEHRAN	1,379	745
RIYADH	1,384	747
DHAHRAN	1,537	830
BENGHAZI	1,537	830
ODESSA	1,539	831
SOFIA	1,542	833
BAHRAIN	1,577	852
DOHA	1,716	927
BELGRADE	1,889	1,020
ABU DHABI	1,934	1,044
DUBAI	2,034	1,098
SHARJAH	2,034	1,098
RAS AL KHAYMA	2,058	1,111
BUDAPEST	2,140	1,156
TRIPOLI	2,174	1,174
ROME	2,309	1,247
VIENNA	2,332	1,259
MOSCOW	2,475	1,336
PRAGUE	2,597	1,402
MUNICH	2,634	1,422
ZURICH	2,779	1,501
GENEVA	2,937	1,586
PARIS	3,093	1,670
KARACHI	3,109	1,679
RAWALPINDI	3,375	1,822
LONDON	3,566	1,925
NEW YORK	9,686	5,230

Table A-5.3

REQUIRED RUNWAY LENGTH FOR AIRCRAFT TAKE-OFF WEIGHT FOR SPECIFIED RANGES

(aerodrome elevation 616 meters AMSL - aerodrome reference temperature 35.7°)

Aircraft Type (Engine Type)	Flight Range (nm)	Take-Off Weight (000 lbs)		Required Runway Length in Meters		Required Landing Length (meters)[1]	Maximum T.O.W. 000 (lbs)	Required Runway Length (meters)[1]
		Maximum Payload	Maximum Payload	Maximum Payload	Maximum Payload			
B747-100	5,300	733	733	3,900	3,900	2,550	733	3,900
(JT9D-7A)	2,100	680	570	2,950	2,000			
B747-200B	5,300	820	700	4,150	3,450	2,550	820	4,150
(JT9D-70)	2,100	680	590	2,175	1,850			
B747SP	5,300	660	630	2,850	2,550	2,050	660	2,850
(JT9D-7A)	2,100	520	480	1,850	1,850			
B727-200	2,100	197	191	3,450	3,000	1,900	197	3,450
(JT8D-17)	1,700	196	183	3,350	2,850			
B707-320B (JT3D-3B)	2,100	267	245	2,550	2,200	2,150	327	3,650
DC-8-55	2,100	265	260	2,600	2,500	2,400	325	4,050
DC-8-63	2,100	315	300	3,300	2,950	2,450	340	4,200
L-1011-200	2,100	410	325	2,450	2,200	2,350	466	3,100
DC-10-30	2,100	435	470	2,900	2,800	2,000	555	4,600
A300B4	2,100	330	325	3,600	3,450	2,200	330	3,600
DC-9-30	800	105	98	2,950	2,500	2,000	108	3,850
B737-200 (JT8D- 9)	800	111	103	3,300	2,000	1,800	111	3,300
B757-200	2,100	230	222	2,900	2,600	1,850	230	2,900
B767-200	1,700	282	278	2,150	2,100	2,000	382	2,150

Source: Manufacturers' specifications.

Note: AMSL = Above mean sea level.

[1] At maximum landing or take-off weight.

The investigated ranges are: 5,300 nautical miles (New York); 2,100 nautical miles (London); 1,700 nautical miles (Munich); and 800 nautical miles (Athens), all of which are dependent on aircraft type.

The table shows that for passenger aircraft (space limited payload) only the B 747-100 requires a runway longer than 3,600 meters on flights to New York.

For all-cargo flights, the picture is almost the same. A runway length in excess 3,600 meters would be required only for the B 747-100 and B 747-200 aircraft for very long stages. At maximum take-off weight, many aircraft types require a long runway (up to 4,600 meters), mainly because of the high reference temperature and aerodrome elevation. Depending on the development of all-cargo flights and on the demand for long flight ranges, a longer runway than is presently available may be required in the future. For planning purposes, this possibility should be taken into consideration. Table A-5.3 shows that the present landing runway 05L-23R is long enough for all types of aircraft at their maximum landing weights.

Consideration should be given to performing all landings on runway 05L-23R and all take-offs on runway 05R-23L, independently of the wind direction. However, this shift would require additional approach and landing aids that are not included in the Consultants' recommendations. It would also require parallel taxiways along both runways.

A parallel taxiway is not required until 1985. Closure of one of the runways would hamper peak-hour capacity considerably, but such closures should be limited.

The maximum LCN of any aircraft at maximum possible take-off weight at the present runway is 110 for 15A conditions. For 15A and 25°C conditions, the maximum LCN is even lower. The load-bearing strength of the present pavements is sufficient for unlimited use.

However, aprons B and C, with a LCN of 35 and a radius of relative stiffness "l" of 90 centimeters, do not have sufficient strength to serve any of the larger aircraft.

One of these aprons, preferably B, could be reserved for purely domestic traffic and the other for general aviation purposes. However, in case the planned pier system of the new terminal building is extended along this apron, large aircraft parking stands along both sides of the pier would be required. This would require reconstruction of apron C to provide the required load-bearing strength.

Widening of apron A is recommended because not enough space is available behind large parked aircraft to taxi. Total apron depth should be at least 145 meters, between the pier facade and the apron edge, to allow for nose-in parking of B 747 aircraft. This depth includes space for an apron service road and for tug vehicles for push-out operations.

From the traffic projections, it can be determined that the number of aircraft parking stands will be adequate through 1985. With apron B reserved for domestic operations and apron C reserved for general aviation, aprons A and D have 11 parking stands, more than required during peak hours.

After 1985 the number of apron parking stands must be increased, especially the number of stands for large aircraft such as DC-10 and B 747 types.

Because of the low usability factor of the runway system for small aircraft, a crosswind runway will be required if the number of such aircraft increases substantially. Although the timing of such an increase cannot be forecast now, a relatively short crosswind runway should be included in the master plan.

Visual and Nonvisual Aids

Analysis of data on reduced horizontal visibility and low cloud base at Damascus Airport, collected from the records of the Meteorological Department, has indicated that there is a real need for the installation of an ILS Category I on runway 05R. Instrument approach procedures should be modified to allow for such an ILS approach on runway 05R. Appropriate monitoring of both ILS systems is a requirement.

The present airfield lighting system requires extension. The ILS installed on runway 23R is Category II, but the system does not permit Category II approaches, because the approach lighting system on threshold 23R has a Category I configuration.

Over the first 300 meters beyond the threshold, the single light sources of the center line off the system should be replaced by a 4-meter-long barrette, and over the first 270 meters, it should be complemented by two side rows of lights consisting of barrettes showing red. Without these additions, the total system is reduced to an ILS Category I. The addition of an inner marker should be considered. The simple approach lighting system on threshold 05R should be extended to a full Calvert approach lighting system when the ILS is installed.

For aircraft with a pilot's eye-to-wheel height exceeding 4.5 meters when in the flare attitude, a two-bar VASIS is not suit-

able as visual glide slope indicator, because it would result in a touchdown before or on the threshold. Hence, for B 747, DC-10, L-1011, and A 300 aircraft a three-bar VASIS should be installed on all landing thresholds. At present, only threshold 23R is provided with such an approach aid. For Category I operations, no changes in the 05R-23L runway lighting system are required, except that the last 600 meters of the edge lighting of both runway directions should show yellow lights. The same applies to runway 05L-23R.

Within the next five to ten years, cable circuits should be replaced: after 15 to 20 years of use, they are subject to failures.

After the replacement of Damascus VOR with modern equipment, a replacement of NDB-ADB and locator DAL remains a requirement. Although these beacons are not yet obsolete, their reliability is limited and with replacement an improved power supply is required.

Daylight marking should be extended. Fixed-distance markings are a firm requirement on all four landing runways. Touchdown marking is required for runway 05R when the ILS is installed. This is also required on runway 23L. In the touchdown zones, the pavements should be cleaned and repainted.

Utilities

Utilities at Damascus International Airport are in good condition and are quite complete. A complete high-tension 20 kv ring main connecting all step-down transformers at the airport needs to be installed. The construction of a second independent high-tension power line connecting the airport to a second power station would increase the reliability of the total system even more.

While the water supply of the airport is adequate, additional storage capacity may be required for the future to cover high peaks. A secondary water supply source and transport system will be required after 1985. The present sewage treatment plant should be repaired as soon as possible. Discharge of untreated sewage in open ditches is not acceptable. With the future increase in water consumption, the capacity of the sewage treatment plant also needs to be increased.

Fire and Rescue Services

Fire protection in accordance with ICAO category 8 should be provided. While the longest aircraft operating into Damascus would require a category 9 protection, the number of movements

is still below the limits set by ICAO. Therefore, a reduction of one category is acceptable.

Because the present fire protection is in accordance with category 7 only, additional fire fighting equipment, or replacement of the old water/foam tender by a larger one, will be required. Within a number of years category 9 fire protection will be required when there are increased movements of B 747 aircraft. A reserve vehicle is also required.

One additional 10,000 liter water/foam tender is required so that the present 8,000 liter water/foam tender can be used as a reserve. After 1985 an additional water/foam tender will be required.

A direct crash road should be built between the fire and rescue station and runway 05L-23R to decrease response time.

With the acquisition of additional equipment, the number of trained personnel must be increased as well. Theoretical and practical training should be intensified, and a fire fighting practicing area should be established. Even with the most sophisticated equipment, the quality of fire fighting and rescue services is heavily dependent on the training of its personnel.

Wider dissemination should be made of manuals relating to fire and rescue procedures, and formal coordinating procedures should be instituted so that essential telephone numbers and names and functions listed are kept currently correct.

Control Tower and Annexes

The control tower is a modern up-to-date facility. The broken windows in the control cabin should be replaced and the cause of the damage should be investigated. The Damascus tower frequencies should be extended in order to reserve a frequency for aerodrome vehicle movement control, especially the fire and rescue services.

Miscellaneous Facilities

Drainage of the strips and the terminal area can be improved by better grading and by cleaning out all culverts.

The airport fence needs replacing by a chainlink fence that gives better protection against unauthorized entrance of people and animals.

As soon as the new terminal building becomes operational, work should start on the existing terminal building in order to convert it into a cargo building. By 1985 the cargo flow through

Damascus is projected to reach 23,500 tons per year. The recently constructed cargo shed will be too small to handle this volume of cargo. After 1990 the combined space of the cargo building and the shed will be too small and further extensions will be necessary unless the handling is more mechanized to increase the handled tonnage per square meter.

With the increased carriage of temperature-sensitive commodities, such as pharmaceuticals and photographic materials, cold storage facilities will be needed. Secure storage facilities for unusually high-valued shipments are also required.

Further extensions to the terminal building will require extensions to the heating and cooling plant. This is not required before 1985.

Catering facilities are working below their capacity. Whether additional facilities will be required in the future depends on airline policies and schedules, but an increase in demand seems to be a reasonable expectation.

Fueling storage and particularly refueling services should be increased considerably to keep pace with the projected increase in aircraft movements.

The road system in the terminal area should be improved. A better separation of passenger traffic and cargo or service traffic should be installed. Service traffic should not pass in front of the terminal building. In the future, all traffic coming from the cargo area, free zone area, hanger area, or the service facilities should not cross traffic to and from the passenger terminal building. In due course, a crossing at separate levels will be required.

The location of the catering buildings is not satisfactory. Better location would be on the security fence, with a public entrance for supply of materials and a customs exit for the transport of meals to the aircraft. The present location does not permit this.

Passenger Terminal Building

The new passenger terminal building under construction is designed for handling both international and domestic passengers. A study of the plans showed that there are a number of locations in the building where the layout is not very efficient or where future bottlenecks will take place. A description of the layout and the flow lines is given in the chapter on infrastructure.

The required peak hour capacities should be as follows for arriving as well as for departing passengers:

Year	1985	-	1,100 Passengers
	1990	-	1,700 Passengers
	2000	-	2,700 Passengers

A main future problem spot is the check-in area with the adjacent customs inspection area. The total peak-hour capacity is about 1,200 passengers, international and domestic; this peak will be reached by 1985. The situation is aggravated by the fact that the group of check-in counters parallel to the facade of the building will cause passenger queuing in front of the counters and will block the passageway of the passengers coming from the other counters. These counters should not be installed. The customs inspection area behind the check-in area would cause chaos and should not be included. Customs inspection of outgoing baggage should be avoided. If this inspection is not stopped, at least the layout should be changed. Inspection should be made before check-in instead of afterwards to eliminate awkward flow lines. The available space is not large enough for a customs inspection area. The area now reserved for this purpose will be required in the near future as an extension of the check-in area. The only possibility for a customs inspection area would be to remove the offices between the check-in area and the central hall and use that area for the check-in area, moving the baggage loading area backward.

In short, the layout should be modified as follows:

- Delete the offices between the check-in area and central hall and use of this area for check-in.

- Relocate the total check-in area, moving it to the area now planned for customs inspection and baggage loading.

- Construct a new baggage loading area closer to the apron.

- Relocate a customs inspection area where the check-in area is now located. Preferably, a red and green zone system will be used.

- After checking in, passengers should not return through the same inspection area but should proceed through a special exit.

The best solution is to delete the inspection and to use the area for check-in purposes.

The total waiting lounge area will be adequate beyond 1985; however, most of the waiting area is located on the first floor. However, not many aircraft will be parked alongside the building, especially during the first development period. This means that the majority of passengers will use the bus gates on the ground floor. This will result in congestion, aggravated by the fact that arriving international passengers will have to cross this part of the waiting lounge on their way from the aircraft to immigration. These two types of traffic should be separated by a partition. The duty free shop should be relocated in the waiting lounge instead of in the area used by arriving passengers.

The fact that international passengers proceed through health, immigration, and customs inspection and enter the public hall before proceeding to the baggage claim area is awkward. It causes inconvenience to passengers because of the double customs inspection and it will require additional personnel. In addition, it creates problems because the passenger flow line crosses the flow line of arriving domestic passengers.

The best solution would be to construct a new domestic terminal building when traffic requires it after 1985. The space now reserved for handling domestic passengers would become available for international passengers. The layout could then be improved substantially. It would create more waiting-lounge area on the ground floor, would enable a better flow line for arriving passengers, and would add space to the international baggage claim area. The passengers would not enter the public hall before claiming their baggage and undergoing customs inspection.

A potential problem is security. With a security control at the entrance of the waiting lounge, the entire waiting area becomes a controlled area. However, the arriving and transit passengers enter this area with no security check.

The solution for security is not simple because a security system was not considered in the original design of the building. If the airside corridor were redesigned and reconstructed to have arriving passengers proceed to the ground floor and from there to the arrival hall and customs inspections, a reasonable separation between arrriving and departing passengers would take place.

The baggage claim area, with only three race-track-type conveyor belts, will have a lower capacity than the other parts of the building.

The maximum capacity in the luggage claim area is some 1,200 peak hour passengers, and the waiting area has a capacity of

1,800 peak hour passengers. With the area now reserved for domestic traffic, the total capacity could be increased to 2,200. These figures include transit passengers. Peak hour capacities of the domestic areas in the building are more than adequate for projected traffic.

The design of both the future domestic passenger terminal building and the extension of the international passenger terminal building should be prepared by specialized consultants in order to avoid wasting money on inadequate facilities.

The domestic terminal building can be a small simple building, preferably located along the edge of apron B. Its capacity should be 120 peak hour passengers, of which as many as 90 could be arriving or departing passengers. The building does not require sophisticated equipment.

With the new terminal not completed for operational use until approximately the end of 1981, some modifications in the present building and processing prodecures should be made.

The government inspection areas should be modified, procedures should be shortened, and waiting time should be cut. This would mean less congestion in the terminal building during peak-hours. Multilingual sign posting should be improved and airport departure tax stamps should be purchased at the check-in counters. Customs inspection for departing passengers should be eliminated.

Table A-5.4 presents preliminary investment recommendations for Damascus International Airport through 1985, and thence to 2000. In addition to updating the old master plan, the recommended priorities through 1985 are as follows:

1. Apron extension.

2. Three-bar VASIS on three thresholds.

3. Approach lighting and ILS on threshold 05R.

4. Upgrading of approach lighting on threshold 23R to Category 2.

5. Modification of existing and new terminal building layouts.

Table A-5.4

INVESTMENT SCHEDULE DAMASCUS AIRPORT

(1980 prices in 000 SP)

Through 1985				
Item	Equipment Cost	Installation Cost	Import Duties	Total Cost
Update Master Plan				780
Modification Terminal Building				5,000
ILS cat I	1500	500	450	2,450
Extension AFL	1600	650	480	2,730
INDB	100	30	30	160
1 Locator Beacon	820	25	25	870
VASIS	500	400	150	1,050
Utilities	2000	500	600	3,100
1 Fire Tender	1600		400	2,000
Extension apron 15,000m2				6,000
Fuel Services				4,000
Fence				1,000
Miscellaneous				2,300
Contingencies				4,760
Total				36,200
1986-2000				
Extension Apron				20,000
Extension Terminal Building				100,000
Domestic Terminal Building				15,000
400 in R.W. Extension				8,000
1000 in Crosswind Runway				60,000
Extension Heating and Cooling Plant				20,000
Extension Catering Building				5,000
Mechanized Handling of Cargo				10,000
Contingencies				44,000
Total				222,000
Additional Investment for Switch-over from F-27 to B-737				
Additional Investment through 1985				None
Additional Investment 1986-2000				
- Further Extension to Future Domestic Terminal Building				25,000
- Overlay Domestic Apron				2,600
- Contingencies 25%				6,000
Total				34,500

Additional Requirements for the Period 1990-2000

Should the Government of Syria decide to switch over from F-27 to B 737 type 8 aircraft in the period between 1990 and 2000, the capacity of the future domestic terminal building shall be increased in order to cope with the increase in peak-hour traffic. Due to the increase in aircraft capacity from 30 to about 100 passengers, it will be necessary to base the peak-hour capacity of the building on 230 arriving or departing passengers instead of 90. Simultaneous departures or arrivals of domestic aircraft should be taken into account for Damascus Airport, as it is the center of the domestic network.

In addition, because of the considerable increase in aircraft LCN for the B 737 compared to that of the F-27, a strengthening of the domestic apron (preferably apron B) should be considered.

While the pavement LCN is about 35, the aircraft LCN is about 45. This will result in future damages to the pavements and hence a considerable increase in maintenance; in the end, it will result in a disintegration of the pavement.

An overlay should be applied.

No other facilities are required.

The additional investment required has been estimated and included in Table A-5.4.

A-5.2 ALEPPO INTERNATIONAL AIRPORT

Recommendations

General

Especially if available space is limited, as at Aleppo International Airport, the importance of timely master planning cannot be overstressed. Not to have a master plan leads to confusion, inefficiency, waste of money, and even lack of safety.

The suburbs of Aleppo are only a few kilometers away from the airport and are extended toward the airport. Aircraft approaching from runway 27 come close to the built-up area or even overfly it.

In order to be able to control more effectively the construction of tall buildings, chimneys, and masts around the airport, the preparation of a map is recommended.

The information on Aleppo International Airport included in the AIP should be upgraded more frequently to reflect changes in the actual situation.

Much of the information in the AIP is neither correct nor complete, especially the information on load-bearing capacity of pavements.

The Consultants' recommendations are based on a number of major assumptions concerning Aleppo International Airport. The first is the recommended change in aircraft type serving the domestic network.

The Consultants consider the following annual average growth percentages of passenger traffic at Aleppo International Airport reasonable:

- 1985 8 percent
- 1990 12 percent
- 2000 15 percent

These growth factors were applied in framing the recommendations.

With widely fluctuating international traffic at Aleppo during the 1970s, it is impossible to base traffic projections on past trends. Instead, projections for Aleppo follow those developed for Damascus International Airport. However, unlike Damascus, little long-haul traffic is likely to use Aleppo. Rather, the traffic is likely to be more of a regional nature.

Pavements

Introduction of the proposed turbopropellor aircraft on the domestic network would have no bearing on pavements. For the larger jet aircraft operating on international routes, the situation is different, because the required runway length is far in excess of the length required for a turbopropellor aircraft.

Table A-5.5 shows the maximum possible take-off weights for a number of aircraft types on the 2,870 meter runway under no wind and ISA + 23.5°C conditions. For these take-off weights, the maximum flight ranges have been calculated for maximum structural payload (cargo flights) and for space limited payload (passenger aircraft). Flight ranges are also shown in Table A-5.1.

To determine future requirements for runway extension, Table A-5.6 has been prepared. This table gives aircraft take-off weights, required runway length, required landing length, and required runway length at maximum aircraft take-off weight. The investigated ranges are 5,300 nautical miles (New York), 2,100 nautical miles (London), 1,700 nautical miles (Munich), and 800 nautical miles (Athens). From this table it follows that for passenger aircraft, most of the aircraft types require a runway no longer than 2,870 meters, except the B 747.

For all-cargo flights the picture is different. Runway length over 3,300 meters would be required.

At maximum take-off weight, almost all aircraft types require a long runway mainly because of the high reference temperature. Depending on demand for all-cargo flights or long flight ranges, a longer runway than the present one may eventually be required.

No parallel taxiway is required at present. However, serving as an alternate to Damascus, the airport may have some peak hours when landing delays would occur. Without a parallel taxiway, widened runway ends must be provided.

The larger aircraft require a considerable pavement LCN for unlimited operations. After completion of the overlay, most of the large aircraft require an LCN 90 on the 61-centimeter-thick flexible pavement, based on the maximum take-off weights on this runway at ISA conditions, which are slightly higher than those listed in Table A-5.1 for ISA + 23.5°C conditions.

Table A-5.5

MAXIMUM ALLOWABLE AIRCRAFT TAKE-OFF WEIGHT AND MAXIMUM FLIGHT RANGES

(runway length 2,870 meters ISA + 23.5°C conditions)

Aircraft type (Engine type)		Maximum allowable T.O.W (lbs)	Maximum Possible Flight Range (Nautical miles)	
			Cargo	Passengers
B747-100	(JT9D-7A)	678,000	2,100	4,100
B747-200B	(JT9D-70)	725,000	3,100	4,500
B747-SP	(JT9D-7A)	660,000	4,900	5,800
B727-200	(JT8D-17)	131,000	1,550	2,100
B707-320B	(JT3D-3B)	295,000	3,100	3,900
DC-8-55		288,000	3,350	3,650
DC-8-63		300,000	1,550	2,150
L-1011-200		466,000	3,250	3,750
DC-10-30		490,000	2,250	2,750
A 300 B4		324,000	1,100	2,050
DC-9-30		106,000	850	1,350
B737-200	(JT8D-9)	110,000	500	1,400
B757-200		230,000	1,600	2,500
B767-200		282,000	950	1,850

Source: Manufacturers' Specifications.

Table A-[illegible]

REQUIRED RUNWAY LENGTH FOR AIRCRAFT TAKE-OFF WEIGHT FOR SPECIFIED RANGES

(aerodrome elevation 389 meters A.M.S.L. - aerodrome reference temperature 36°C)

Aircraft Type (Engine Type)	Flight Range	Take-Off Weight (000 lbs) Maximum Structural Payload	Take-Off Weight (000 lbs) Maximum Space Limited Payload	Required Runway Length in Meters Maximum Structural Paylaod	Required Runway Length in Meters Maximum Space Limited Payload	Maximum Required Landing in Meters	Maximum Take-Off Weight (000 lbs)	Maximum Required Take-Off Runway Length
B747-100 (JT9D-7A)	5,300	733	933	3,750	3,750	2,375	733	3,750
	2,100	680	570	2,900	1,900			
B747-200B (JT9D-70)	5,300	820	780	3,925	3,400	2,375	820	3,925
	2,100	600	590	2,475	1,875			
B747SP (JT9D-7A)	5,300	660	630	2,725	2,475	2,000	660	2,725
	2,100	520	480	1,750	1,750			
B727-200 (JT8D-17)	1,700	196	183	3,285	2,525	1,850	197	3,275
	2,100	197	191	3,275	2,850			
B707-320B (JT3D-3B)	2,100	267	245	2,350	1,950	2,150	327	3,550
DC-8-55	2,100	265	260	2,500	2,450	2,050	325	3,800
DC-8-63	2,100	315	300	3,150	2,850	2,300	345	4,250
L-1011-200	2,100	418	395	2,250	1,950	2,300	466	2,850
DC-10-30	2,100	485	470	2,800	2,700	1,950	555	4,400
A300B4	2,100	330	325	3,400	3,000	2,150	330	3,400

Table A-5.6 (Continued)

REQUIRED RUNWAY LENGTH FOR AIRCRAFT TAKE-OFF WEIGHT FOR SPECIFIED RANGES

(aerodrome elevation 389 meters A.M.S.L. - aerodrome reference temperature 36°C)

Aircraft Type (Engine Type)	Flight Range	Take-Off Weight (000 lbs)		Required Runway Length in Meters		Maximum Required Landing in Meters	Maximum Take-Off Weight (000 lbs)	Maximum Required Take-Off Runway Length
		Maximum Structural Payload	Maximum Space Limited Payload	Maximum Structural Payload	Maximum Space Limited Payload			
DC-9-30	800	105	98	2,825	2,125	2,375	733	3,750
B737-200 (JT8D-9)	800	113	103	3,275	2,350	1,200	113	3,275
B757-200	2,100	230	222	2,450	2,250	1,800	230	2,450
B767-200	1,700	282	278	2,100	2,050	1,950	282	2,100

Source: Manufacturers' specifications.

To provide the higher LCN, an additional 5 centimeter thick asphalt concrete overlay is required. However, since the pavement is able to stand a limited number of aircraft with an LCN 90, the overlay can be postponed beyond 1985.

The apron size permits simultaneous parking of three medium-size aircraft. However, parking of a large aircraft would block independent movement to and from other stands. An apron depth of about 125 meters is required for independent parking of three large aircraft.

The apron is located too close to the buildings. A buffer area of about 50 meters between the building facade and the apron edge is recommended. The apron needs to be extended 90 meters towards the runway.

To provide parking space for aircraft diverted from Damascus, a number of additional parking stands are required. Contrary to most other airport facilities, the availability of parking stands is not flexible. Thus, the Consultants recommend that the number of apron parking stands be at least 40 percent of the number of stands at Damascus Airport.

The existing apron should be given an overlay in order to increase the load-bearing capacity to the same value as other pavements. An overlay thickness of 10 centimeters is required.

The runway should be properly graded, and all manhole covers extending above the surface must be flush.

Visual and Nonvisual Aids

The existing NDB should be replaced by a VOR, preferably collocated with DME. This beacon has already been recommended in Chapter A-4 as a navigational aid. The same beacon can be used to determine instrument approach procedures.

The present airfield lighting system should be upgraded and extended. The system is 15 years old and new equipment will be required within a short period of time. The airfield lighting cables are close to the end of their economic life and should be replaced.

The runway edge lighting should be extended with a stopway edge lighting showing red light in the approach direction.

With the installation of an ILS, for which category 1 is adequate, a full Calvert approach lighting system should be installed on the ILS threshold, and a simple approach lighting system should be installed on the other threshold. The simple

approach lighting system should be extendible to a Calvert approach lighting system. Threshold lights should be located in accordance with ICAO Annex 14, requiring a number of flush inset light fixtures. Three-bar VASIS on both landing thresholds are required to serve as an approach slope indicator for all types of aircraft. Brightness control on all circuits is required. Extension of the apron edge lighting system and apron flood lighting will be required.

Daylight markings must be provided. In addition to present runway markings, the following markings should be provided to meet ICAO recommendations and standards:

- fixed distance markings, and
- touchdown zone markings, especially on the ILS runway.

Utilities

The capacity of the high-tension power supply line to the airport should be checked to meet the needs of the AFL systems and the terminal area. At least two additional emergency power-generating sets should be installed. For the ILS, automatic starting generating sets should be provided with switch-over times of one second.

Water close-up storage should be installed with pressurizing devices. The telephone system should be increased.

Fire and Rescue Services

Fire protection in accordance with ICAO category 7 should be provided. This is two categories below the category required for the largest aircraft expected. Category 7 requires a total water capacity of 18,700 liters. In addition to the large foam tenders, a rapid intervention vehicle and two ambulances will be required along with one reserve vehicle.

All vehicles should be parked in a new fire and rescue station, with at least six bays, stores, workshops, and a dormitory.

Control Tower and Annexes

A major problem with the present tower is its limited eye level. With large aircraft on the apron, the line of sight of the controller is blocked and part of the runway and approach areas are not visible. The construction of a new, higher control tower is required. It could be erected on top of the new terminal building.

Communications equipment should be relocated, and a new AFL equipment room should house the extended number of CCR (Communications Control Regulators), switchboards, distribution panels, and transformers.

Terminal area control should be installed. The existing annex to the control tower could be used to house the airport administration, meteorological services, workshops, and pilot briefings. Replacement of the old teletype equipment will be required.

Miscellaneous Facilities

Drainage of the strip area and the extended apron area must be improved. Because of the increase in apron area, the stormwater discharge peak will increase considerably. At the edges of the apron, in the terminal area, and along the runway, a surface drainage system will be required.

The airport should be enclosed by a chain-link fence.

The construction of a small, extendible cargo building is recommended. Manual cargo handling can be used through 1985, but it would be advisable to design the height of the building so that future mechanical handling would be possible.

An airport maintenance yard with stores and workshops should be constructed.

Passenger Terminal Building

The present passenger terminal building is neither large enough nor laid out adequately to serve international flights. It cannot handle simultaneous international and domestic flights. Separation of the two types of passengers is not possible. A new passenger terminal building should be constructed for international traffic. The design should be carried out by specialized airport consultants. The size of the building should be sufficient to handle normal peak-hour traffic, without diverted traffic.

The terminal building should contain all normal passenger facilities:

- departure hall with check-in counters,
- waiting lounge with bar and a small restaurant or snack counter,
- baggage claim area,
- arrival hall,
- customs inspection areas,

- toilets,
- airline offices,
- information counters, and
- a passenger information system.

After completion of the new building, it would be possible to convert the existing building into a domestic passenger building.

For the time being, a considerable increase in space in the terminal building can be obtained by removing a number of offices and other facilities and by housing them in a temporary building

Apron Services

For the domestic network, Aleppo is the most important station after Damascus. It could also develop as a junction point in the network. In the international network a number of relatively long as well as regional flights may take place. For both types of traffic, the apron services should be improved. All types of apron services should be provided, such as toilet and cabin cleaning, water supply, air conditioning, engine starting, aircraft towing, and catering. Efficient and fast handling of passenger baggage and of cargo is essential. More trained personnel and equipment are required.

The provision of fuel is essential, and the storage capacity of Jet A 1 fuel as well as the number and capacity of fuel trucks must be increased to handle increased demand by high capacity, aircraft. Refueling capacity should be based on normal scheduled flights and not on peak. The storage capacity, however, should cover peaks caused by diverted traffic as well.

Maintenance

At Aleppo and the other domestic airports, present provisions for facility maintenance are inadequate. This applies to all types of maintenance work, including pavements, buildings, electronic and electrical equipment, AFL, and power generators. A study should be conducted to determine the most effective means of providing the required maintenance services from among the alternatives of resident staff and facilities, contractors, and travelling maintenance crews. First and foremost, the recommended maintenance system should be the most economical system, in terms of costs and scarce technical personnel, that can provide the requisite level of maintenance without undue delay.

Investment Schedule

Table A-5.7 presents preliminary investment recommendations for Aleppo International Airport through 1985 and also through

2000. The priorities through 1985, after completing a master plan for the airport, should be:

1. International Terminal Building and Tower.
2. Apron extension.
3. Airfield lighting.
4. Navigation and landing aids.
5. Fire and rescue equipment.

Between 1985 and 2000, depending on the master plan and the development of traffic, suggested priorities are:

1. Runway overlay.
2. Parallel taxiway.
3. Apron extension.
4. Terminal building extension.

Table A-5.7

INVESTMENT SCHEDULE ALEPPO AIRPORT

(1980 prices-000 SP)

Through 1985

Item	Equipment Cost	Installation Cost	Import Duties	Total Cost
Master Plan				800
New International Teminal Building	NR	NR	NR	20,000
Modification Existing Terminal Building	NR	NR	NR	1,000
Extension AFL	2,000	800	600	3,400
VASIS three-Bar	360	280	110	750
VOR/DME				P.M.
Overlay Apron	NR	NR	NR	770
Extension Apron 50,000	NR	NR	NR	10,000
Tower	NR	NR	NR	2,000
ILS on 27 threshold	1,50	500	450	2,450
Fence	500	200	150	850
Airport maintenance Yard	NR	NR	NR	1,000
Widened runway ends	NR	NR	NR	1,500
Fire & Rescue Station	NR	NR	NR	2,000
3 Fire tenders	3,500	NR	1,050	4,550
1 ambulance	100	NR	30	130

Table A-5.7 (Continued)

INVESTMENT SCHEDULE ALEPPO AIRPORT

(1980 prices 000 SP)

Item	Equipment Cost	Installation Cost	Import Duties	Total Cost
Utilities	200	80	70	350
Miscellaneous	NR	NR	NR	2,250
Contingencies	NR	NR	NR	8,100
Subtotal				61,900
1986-2000				
Parallel Taxiway				18,000
Overlay Runway & Taxiway				3,600
Extension Terminal Building				12,000
Extension Apron				6,000
Shoulders				5,000
Contingencies				11,400
Subtotal				55,600
Additional Investment for Switch-over from F-27 to B-737				
Additional Investment 1986-2000				
- Extension to Domestic Terminal Building				9,000
- Contingencies 25%				2,250
				11,250
Grand Total				128,750

Source: Consultants' estimates.

Note: NR = Not relevant.

A-5.3 LATTAKIA AIRPORT

Recommendations

General

The following recommendations assume that turbopropeller type aircraft will serve the domestic network.

It was decided in principle by the Syrian Government to convert and expand Lattakia Airport into an international airport. This decision was not taken on technical or economic grounds. There is no recorded demand for international services.

The Consultants are not in a position to comment on this approach and cannot give any projections for international air traffic at Lattakia. Hence, no recommendations can be made covering facilities that an international airport would require.

Pavements

The existing runway length at Lattakia Airport is more than adequate for turbopropeller aircraft. Corrected for aerodrome elevation and reference temperature, the F-27 requires a runway length of 1,300 meters.

No parallel taxiway is required.

Normally, only one aircraft will be parked on the apron at any time, but depending on flight schedules and emergencies, a second one might require parking space simultaneously. The apron size allows for simultaneous parking of two aircraft of F-27 size, but some repairs are necessary, and cracks should be properly sealed.

Visual and Nonvisual Aids

Based on available data, it has been determined that an instrument landing system is not required.

In order to enable the domestic airline to maintain a regular schedule with rather high frequency, night operations should be accepted. For that purpose, an airport lighting system in accordance with ICAO Annex 14 for nonprecision instrument approach runways is required. This AFL system is also an advantage when there is a low cloud base or reduced visibility.

Installations of a two-bar VASIS on both thresholds is required to give pilots a proper indication of the correct glide path.

Other parts of the recommended AFL system are high intensity, elevated runway edge lighting, with threshold and runway end lights, simple approach lighting systems on both thresholds for directional, distance, and roll guidance, taxiway and apron edge lighting; limited apron flood lighting; and an aerodrome rotating beacon.

All systems should be divided into two independent circuits for safety reasons.

All pavements must be provided with daylight markings in accordance with ICAO Annex 14 standards and recommendations for an instrument approach runway.

The existing new NDB will serve as an approach aid. No additional beacons will be required.

Utilities

Lattakia Airport is not connected to any outside utility system, except for a telephone line.

Because Lattakia city is 20 kilometers from the airport, whether connections to the existing power and water supply systems are feasible, or whether it is cheaper to provide for these utility systems at the airport itself, should be examined. Reliable power and water supply systems are required.

Emergency power generators should be installed to cover periods of main power failure. An automatic starting device and a switchover time of not more than 15 seconds is required.

The installation of a water tower or tank is recommended.

The telephone system requires an extension, and a connection should be installed.

Fire and Rescue Services

Because only smaller aircraft will service the airport, the ICAO fire protection category 4 will suffice. The construction of a fire and reserve station, the purchase of a rapid intervention vehicle and one or two foam tenders, provided a spare foam tender is available, will all be required.

The total capacity requirement for the water/foam tenders is 3,600 liters of water, with a discharge rate of 2,600 liters per minute.

Control Tower

The existing control tower is completely inadequate. It does not permit surveillance of major parts of the runway, the apron, or the approach areas.

A new control tower at a more favorable location is an urgent requirement. The eye level of the control cabin should be approximately 20 meters above ground level.

Equipment should be installed in the new tower and the old tower should be demolished.

Miscellaneous Facilities

The airport should be fenced-in properly. Although there is a boundary fence, the old runway is not fenced in, and a gap in the fence exists where the old runway crosses the fence. This should be remedied.

The existing fence should be replaced before 1985 by a chain link fence.

The airport drainage should be improved. An interception ditch should be put in along the east side of the airport. The runway strip should be graded properly.

No cargo-handling facilities exist. Although the cargo and transport are limited, a small, extendible cargo building should be provided.

Passenger Terminal Building

The existing terminal building is not usable and should be demolished. The new passenger terminal building under construction is designed for the handling of international and domestic passengers. The size of the building is such that there is ample space for domestic services. However, the layout of the building is inefficient. Arriving domestic passengers must cross the waiting lounge on their way to the baggage claim area on the other side of the building, collect their baggage, and return to an exit door. This reduces the effective waiting lounge utilization substantially. Flow lines of departing and arriving passengers should not cross each other. Domestic arriving passengers could use the corridor for the international passengers, after some modifications to the design.

However, these remarks are only applicable to domestic traffic handling. A complete redesign of the interior of the building would be required for combined domestic and international traffic.

The location of toilets for domestic passengers, departing as well as arriving, is not clear. The toilets in the basement are behind the customs and immigration barrier, hence not within reach of the travelling public.

Apron Services

For serving the domestic network, apron services can be limited. Stopovers of 10-15 minutes are anticipated. Thus no extensive servicing will be possible. However, efficient handling of passenger baggage is essential. More trained personnel and additional baggage carts are required.

The provision of fuel might not be economically feasible, but this is mainly a matter for the oil company.

Maintenance

Based on the results of the maintenance system study recommended in the discussion on Aleppo Airport, an adequate system of facility maintenance should be established.

Expansion Requirements for International Operations

Preliminary plans exist to develop Lattakia Airport into an international airport. These plans are not based on technical requirements or on existing or projected traffic demand.

The Consultants are not in a position to comment on the justification of these preliminary plans in the absence of a feasibility study.

However, a number of observations are presented here that may be useful if the airport is extended for international operations.

The first requirement is that a master site plan be prepared by specialized consultants.

The Consultants investigated the operational possibilities on the existing runway, with a length of 2,500 meters and under 15A + 15°C conditions. The data are given in Table A-5.8.

The table shows that all aircraft types are able to takeoff from the runway under hot weather conditions at reasonable take-off weights.

However, the runway load-bearing capacity does not allow for more than emergency use by any larger aircraft, except for the DC-9-30 and B 737. Strengthening all pavements is required before any operation by larger aircraft.

Table A-5.8

MAXIMUM ALLOWABLE AIRCRAFT TAKE-OFF WEIGHT
AND MAXIMUM FLIGHT RANGES

(runway length 2,500 meters under 15A and 15°C conditions)

Aircraft Type	(Engine Type)	Maximum Allowable T.O.W. (lbs)	Maximum Possible Flight Range (nautical miles)	
			Cargo	Passengers
B747-100	(JT9D-7A)	675,000	2,000	4,000
B747-200B	(JT9D-70)	715,000	2,900	4,300
B7474SP	(JT9D-7A)	660,000	4,900	5,800
B727-200	(JT8D-17)	190,000	1,500	2,050
B707-320B	(JT3D-3B)	295,000	3,100	3,900
DC-8-55		280,000	3,000	3,300
DC-8-63		292,000	1,300	1,900
L-1011-200		455,000	3,050	3,550
DC-10-30		482,000	2,100	2,600
A300B4		326,000	1,150	2 100
DC-9-30		107,000	900	1,400
B737-200	(JT8D-9)	109,000	450	1,350
B757-200		230,000	1,600	2,500
B767-200		282,000	950	1,850

Source: Manufaturers' Specifications.

Strengthening of the flexible part of the pavement can be done by the application of an asphalt concrete overlay or by reconstruction. Because the sub-base and base courses are not thick, a costly reconstruction would be required. A very thick asphalt concrete overlay would be very expensive.

The heaviest aircraft require an LCN 110 on the existing pavement, more than twice the present bearing strength. Such reconstruction would require an additional crushed aggregate base course and a new asphalt concrete surface course.

The rigid pavements require strengthening by an overlay to bring them up to the same standard as the other pavements.

This would require closure of the airport for one to two years.

International traffic by DC-9-30 and B 737 type aircraft may be serviced with the present runway, but for heavier aircraft a reconstruction would be required.

The apron depth is limited. As long as there are no more than two medium-size aircraft parked, there are no problems. With more aircraft, an extended apron would be required with an apron taxiway. The depth between the center line of the parallel taxiway and the facade of the building will not permit parking of medium- or large-size aircraft. Any extensions to the apron should be deeper than the existing apron.

Operations by large aircraft would require an increase in fire protection at least to ICAO category 7. At least one full Calvert approach lighting system on threshold 7 and three-bar VASIS on both thresholds would be required.

Installation of an instrument landing system should be considered on one threshold. This would require a switch-over of the emergency power supply of one second.

The terminal building under construction cannot handle more than about 40 departing and 40 arriving international passengers without seriously hampering domestic flights. The capacity of the building might be increased somewhat by a more efficient interior layout, but improvements would be marginal. Redesign of the interior layout of the building is required in any case because there are too many conflicting flow lines and bottlenecks in the present layout.

Redesign of the layout by specialized consultants should be considered as a firm requirement and as a matter of urgency.

The building under construction does not have enough capacity to serve medium to large jet aircraft. Although these aircraft will not operate at the airport in the near future, this problem should be kept in mind for master planning purposes.

Investment Recommendations

Investment recommendations for improvements and additional facilities required for domestic operations are given in Table A-5.9 through 1985 only. Subject to findings of a master plan for Lattakia the immediate priorities for the investments shown in Table A-5.9 are:

1. Control Tower.

2. Terminal building revised layout.

3. VASIS.

4. Airfield lighting.

Additional investment estimates for switch-over from F-27 to B 737 have also been included. It needs to be pointed out that the amount of investment required will depend on whether the airport will serve international traffic by 1995 or not.

With international traffic, the extension of the terminal building should be far more extensive than without international traffic, because in the latter situation the entire available space in the new building may be used for domestic traffic.

For the estimates of additional investment it has been assumed that no international traffic will serve the airport. Should this be incorrect, then additional investments would be required at an earlier year in order to support such international traffic. An example is the fire and rescue service. The recommendation includes category 4 protection for B 737 aircraft on the domestic network; category 5 protection is required, but international traffic may require a category 7 protection.

The required category 5 protection requires an increase in capacity of the water/foam tenders from 3,600 to 8,100 liters, with a discharge rate increased from 2,600 to 4,500 liters per minute. This requires additional tenders, and the fire and rescue station should be extended as well.

Miscellaneous investments will also be required in apron equipment, etc. An itemized break-down in additional requirements is included in Table A-5.9.

Table A-5.9

INVESTMENT SCHEDULE LATTAKIA AIRPORT

(1980 prices 000 SP)

Through 1985

Item	Equipment Cost	Installation Cost	Import Duties	Total Cost
Modification Terminal Building	NR	NR	NR	2,000
New Control Tower and Annexes	NR	NR	NR	2,000
Cargo Building 400m2	NR	NR	NR	600
ALS	2,200	890	660	3,750
VASIS	280	200	80	560
Fence	500	200	150	850
Utilities	2,000	500	600	3,100
Fire and Rescue Station	NR			1,000
2 Fire Tenders	1,400		420	1,820
1 Rapid Intervention Vehicle	300		90	390
Miscellaneous				1,180
Contingencies				2,590
Subtotal				19,840

Additional Investment for Switch-over from F-27 to B-737

Additional Investment 1986-2000	
- Extension Domestic Terminal Building	2,000
- Extension Fire and Rescue Station	1,500
- Additional Fire and Rescue Vehicles	1,500
- Miscellaneous	1,400
- Contingencies	1,600
Subtotal	8,000
Grand Total	27,840

Source: Consultants' estimates.

A-5.4 DEIR EZ ZOR AIRPORT

Recommendations

Pavements

The bearing strength of the pavements at Deir Ez Zor Airport is LCN 30. This is above the strength required for a fully loaded Caravelle and considerably above that required by a turboprop aircraft. Thus, no major work on the runway is required. Joints and cracks need to be repaired. The runway length is well in excess of the 1,730 meters required by the F-27 type aircraft. The 40 meter width is adequate and above the ICAO runway code C.

Although the turboprop aircraft requires only a short runway, the military still needs the full length of 3,000 meters. It would not be practical to limit the civil part to 1,750 meters only. Because the long runway already exists and does not require major investments, use of the entire length enables closures of part of the runway for repairs and maintenance without a closure of the entire runway.

Incidental use of the long runway remains open, but in view of the limited load-bearing capacity, this is a questionable advantage, except for emergency operations. Although the longer runway requires some additional investments in marking and airfield lighting, this is partly compensated for by the fact that no expensive flush inset light fittings are required for the threshold and simple approach lighting system.

A lengthening of the connecting taxiway between the parallel taxiway and runway would serve all civil requirements. The parallel taxiway is in fact a military requirement. It would be convenient to have civil aircraft use it for safety purposes. The lengthening of the connecting taxiway would be useful for operational reasons.

It should be mentioned that the distance between the center lines of the runway and the parallel taxiway is 142.5 meters only. This distance is not within the recommendations of ICAO for instrument approach runways, which is a minimum distance of 184 meters.

In case civil aviation is forced to use the parallel taxiway, a thin asphalt concrete overlay should be applied to the flexible part of it. Although the LCN 15 just meets the required value, the surface condition of the pavement is too poor for daily operations.

The apron and taxiway, are of the same construction as the flexible part of the parallel taxiway and also require asphalt concrete overlay.

Normally, only one aircraft will be parked on the apron at any one time, but depending on flight schedules and emergencies, a second could be parked simultaneously. The apron requires a small extension for that purpose and to allow for more distance between the terminal building and the apron edge.

Visual and Nonvisual Aids

Based on available data, it has determined that no requirement for more sophisticated approach aids than a VOR exits at Deir Ez Zor Airport.

In order to enable the domestic airline to maintain a proper schedule with rather high frequencies, night operations should be accepted. For that purpose, an airfield lighting system is required in accordance with ICAO Annex 14 for nonprecision instrument runways. This AFL system is also an advantage when there is a low cloud base or reduced visibility.

A firm requirement is the installation of a VASIS on both thresholds to give pilots a proper indication of the correct glide path. Because of the recommended type of aircraft, bar VASIS will cover all requirements.

Other parts of the recommended AFL system are high-intensity elevated runway edge lighting with threshold and runway end lights; simple approach lighting systems on both thresholds for directional, distance, and roll guidance; taxiway and apron edge lighting; limited apron flood lighting; and an aerodrome rotating beacon. All essential systems should be divided into two independent circuits for safety reasons.

All pavements should be provided with daylight markings, in accordance with ICAO Annex 14, and all confusing military marking should be removed.

In the recommendations on the air navigation system, a VOR/DME is proposed at Deir Ez Zor as a navigational aid for a new airway to Baghdad. This beacon may be used fruitfully for the establishment of new instrument approach procedures.

Utilities

A new high-tension power line between the town of Deir Ez Zor and the airport should be installed to guarantee an adequate,

reliable, and stable power supply. Nevertheless, a small emergency power house with at least low-power generators should be installed to cover periods of main power failure to enable maintenance. One spare engine should be installed.

Both the water supply and the telephone system may need some upgrading. A teletypewriter connection should be installed for DGCA as well as for Syrianair.

Fire and Rescue Services

Because of the smaller aircraft serving the airport in the future, the ICAO fire protection category may be reduced to 4, one category below that for an aircraft length of about 25 meters. This reduction is justified because of the low frequency of movements. However, with the planned increase in movements that would result with the introduction of smaller aircraft, the DGCA should provide itself with the required fire protection by constructing a fire and rescue station and buying a rapid intervention vehicle and one or two foam tenders (provided a spare foam tender is available in Syria).

Control Tower

It is possible to modernize the existing control tower, but it might be economically feasible to build a new one. In any case, AFL mini-panels and control desks should be installed and all equipment should be properly connected without "knotting" the wires to each other, as is common practice at all airports.

Miscellaneous

The airport should be properly fenced in, preferably by a chain-link fence. This safety measure is essential to stop people or animals from entering the airport.

Passenger Terminal Building

The existing terminal building is already close to the end of its economic life. Although it is in a rather fair condition, the layout is completely inefficient and would seriously hamper future domestic operations. Even major reconstruction work would not allow for the future efficient, fast, and comfortable handling of passengers required for a better functioning of the domestic air transport network.

A small, modern, and efficient new terminal building should be designed and constructed along the apron edge. The size of the building should be adequate to handle initially 30 to 40 departing and 30 to 40 arriving passengers within a short period, with all accommodations required for the passengers. Additional space should be provided for people accompanying departing passengers or meeting arriving passengers, the "meeters and greeters."

Check-in counters, waiting lounge, toilets, baggage claim area, airlines offices, etc., should be included in the building design. No sophisticated equipment such as conveyor belts are required. No luxurious building is required, just an efficient one. However, because of the rather extreme climate conditions, the building should be provided with heating and cooling. Instead of cooling, natural cross ventilation may be adequate, but since the wind speeds are normally very low, some air conditioning might be required.

A separate cargo building is not justified through 1985 at least, but may be built later in case demand for cargo transport develops. In the design of the terminal building a small space for cargo handling should be reserved. If in the future a separate cargo building were built, the space could then be used for other purposes.

A separate cargo building is not justified through 1985 at least, but may be built later in case demand for cargo transport develops. In the design of the terminal building a small space for cargo handling should be reserved. If in the future a separate cargo building were built, the space could then be used for other purposes.

With the town of Deir Ez Zor not far away and planned waiting lines in the building limited, the provision of a restaurant seems justified only in case the additional investment is compensated by the fee paid by the concessionaire to DGCA. A small refreshment counter should be provided.

Altogether, a passenger terminal building of about 700 to 900 square meters? will be required in the first phase. The building should be designed so that it can be extended to meet future developments.

During construction of a new terminal building it is important that the execution of major reconstruction work does not hamper operations in the existing building.

For comparison reasons it should be mentioned that introduction of larger jet aircraft on the domestic network would require the construction of a more sophisticated building of about three times the capacity of the building now proposed.

A standard passenger terminal building should be designed for Deir Ez Zor, Al Kamishli, and Palmyra.

The existing building might be reconstructed for the purpose of housing additional services and personnel. However, in view of the age of the building, a new office building will be required after 1985.

Services

Because Deir Ez Zor is in the middle of the eastern part of the domestic network, fueling service should be available. This is both an operational point and an economic one.

Limited apron services are justified in order to serve domestic flights. For instance, toilet cleaning should be considered at Deir Ez Zor.

Efficient handling of passenger baggage will require more baggage carts and sufficiently trained personnel.

Maintenance

Based on the results of the maintenance system study recommended in the discussion on Aleppo Airport, an adequate system of facility maintenance should be established.

Major construction contracts should be awarded to capable, specialized contractors, local or foreign, with adequate supervision of construction. The current system with automatic awards to Government companies and without adequate supervision results in below-standard construction quality and hence in inadequate facilities and high maintenance costs.

Airport construction is too specialized to expect an acceptable quality of work if work is executed by a nonspecialist. Most road contractors will not be able to build a good-quality runway, and most contractors are not capable of constructing terminal buildings.

Closure of entire airports for maintenance, repair, or overlay work causes serious disruption and should not be permitted.

Investment Recommendations

Recommended investments in improvements and equipment through 1985 for Deir Ez Zor Airport are shown in Table A.5-10. Suggested priorities are:

1. Pavement improvements.

2. New terminal building.

3. Air navigation and landing aids.

4. Airfield lighting.

5. Fire and rescue station and vehicles.

Estimates have also been made for the additional investment in the 1986-2000 period that will be required if a decision is made to switch over from F-27s to B 737s.

Of all domestic airports, Deir Ez Zor requires the most extensive additional investments, even more than the original Phase I investments.

The new terminal building should be extended in order to cope with the increase in peak-hour traffic, as the numbers of peak-hour arriving or departing passengers will increase from 30 to 100.

The fire protection will need to be increased from category 4 to 5, which will require additional water/foam tenders and additional space in the fire and rescue station.

Furthermore, the apron, taxiway, and extended taxiway will require an overlay to increase their load-bearing capacity. These flexible pavements, consisting of old pavements with a thin overlay as recommended in the Phase I Report, have a LCN of about 20, while at least an LCN 40 is required for the B 737.

The main problem will be to increase the strength of the runway. The present LCN 30 of the rigid pavements should be increased to LCN 45 in order to provide enough load-bearing capacity for the B 737. Due to the fact that the pavements are of a rigid type, strengthening of the pavements is a major problem, requiring a considerable investment. A breakdown of the additional investment by major items is included in Table A-5.9.

Table A-5.10

INVESTMENT SCHEDULE DEIR EZ ZOR AIRPORT

(1980 prices)

Through 1985	Equipment Cost (000)	Installation Cost (000)	Import Duties 30 percent	Total Cost (000)
New Terminal Building 800 m^2 or 6000 SP	NR	NR	NR	4,800
Overlay Apron and Taxiway 10,000 m^2 4 cm or 4SP/cm/m^2	NR	NR	NR	160
Lengthening Taxiway 35,000 m^2 or 200 or 200 SP/m^2	NR	NR	NR	700
AFL	2,200	890	660	3,750
VASIS	280	200	80	560
VOR/DME	1,200	300	360	1,860
Fire and Rescue Station	NR	NR	NR	1,000
2 Fire Tenders	1,400	NR	420	1,820
1 Rapid Intervention Vehicle	300	NR	90	390
Communications	1,000	NR	300	1,300
Fence	500	200	150	850
Utilities	480	150	150	780
Miscellaneous	NR	NR	NR	1,030
Contingencies				2,850
Subtotal				21,850

Table A-5.10 (Continued)

INVESTMENT SCHEDULE DEIR EZ ZOR AIRPORT

(1980 prices)

Additional Investment Schedule	Total Cost (000)
Additional Investment 1986-2000	
- Extension New Terminal Building	10,000
- Extension Fire and Rescue Station	1,500
- Additional Fire Tender	1,500
- Overlay on Taxiway and Apron	1,000
- Overlay on Runway	12,000
- Miscellaneous	1,000
- Contingencies 25%	6,900
Subtotal	33,900
Grand Total	55,850

Note: NR = Not relevant.

A-5.5 AL KAMISHLI AIRPORT

Recommendations

Pavements

Assuming the introduction on the domestic network of turboprop aircraft, of which the largest type is the F-27, a pavement bearing strength of LCN 16 and the application of an asphalt concrete overlay of some eight centimeters would bring the load-bearing capacity up to requirements. Furthermore, introduction of turboprop aircraft would no longer require a long runway at Al Kamishli. Compensated for aerodrome altitude and temperature, the F-27 aircraft would require a balanced field length of 1,750 meters. This means that the southern 1,000 meters of the present runway, the part with the poorest construction, could be abandoned and the overlay applied on the northern 1,750 meters of the runway. After reconstruction work, the minimum traversal slope of the runway pavements should be 1 percent.

Shortening of the runway would also result in lower cost for other facilities.

The turboprop aircraft require a basic runway length within the range of an ICAO runway code C.

For such a runway, the recommended width should be at least 30 meters. Taking into account the existing pavement width of 50 meters (including shoulders) and the rather strong crosswinds that occur in Al Kamishli, a 35 meter runway width is recommended with 7.5 meter wide shoulders. This recommendation requires an asphalt concrete overlay over the 35 meter width tapered out over part of the shoulder width.

The present location of the apron prevents instrument approach procedures on the runway in accordance with ICAO recommendations. Aircraft on the apron can be parked only within the 150 meter runway strip and extending partly above the transitional surface. Although under normal circumstances no aircraft will use instrument procedures for some time with a second aircraft parked on the apron, eventually this may occur more frequently. For planning purposes, this should be taken into account. New facilities should be constructed at locations to permit future instrument approach procedures to meet ICAO recommendations.

The condition will require the relocation of the apron. A more appropriate location would be about 800 meters south of threshold 21 halfway along the shortened runway, allowing landing turboprops to turn off at the end of their landing run. This

location would require a completely new terminal area. An alternative would be to move the terminal area towards the road from Al Kamishli to Al Hassakeh, with a subsequent relocation of the apron before it becomes an operational hazard. This would require a diversion of the main road from Al Kamishli to Al Hassakeh. The diversion is required in any case because the depth of the terminal area is too small. This alternative should be studied during the master planning recommended for the airport. From an operational point of view, the relocation southwards is preferred in the first phase. Construction could start immediately, without waiting for the road diversion.

If the existing apron continues to be used for aircraft parking, an overlay of three centimeters would be required, except for the edges of the old apron. These parts should be reconstructed instead of overlaid. An extension to the apron to allow for simultaneous parking of two aircraft is also required.

Visual and Nonvisual Aids

On the basis of available data, it has been determined that no sophisticated approach aids are required.

To enable the domestic airline to maintain a high-frequency schedule, night operations should be possible. For that purpose an airfield lighting system in accordance with ICAO Annex 14 for nonprecision instrument runways is proposed. This AFL system is also an advantage when there is a low cloud base or reduced visibility.

The installation of a two-bar VASIS will be required on both thresholds to give pilots a proper indication of the correct glide path. Other components of the AFL system are high-intensity elevated runway edge lighting, with threshold and runway end lights; simple approach lighting systems on both thresholds for directional, distance, and roll guidance; taxiway and apron edge lighting; limited apron flood lighting; and an aerodrome rotating beacon.

All essential systems must be served by two independent power circuits for safety reasons. The existing old, obsolete NDB should be replaced by new solid-state equipment. This equipment may be used by turboprop aircraft for nonprecision approach procedures.

All pavements should be provided with daylight markings in accordance with ICAO Annex 14.

Utilities

Although the power supply to the airport was reported to be satisfactory, the increase in power demand may require up-

grading the line. Additional emergency power generators are required, with devices for automatic switch-over within 15 seconds.

Water supply and telephone systems must be improved. A teletypewriter connection should be installed for use by DGCA and by Syrianair.

Fire and Rescue Services

Fire protection in accordance with ICAO category 4 should be provided. While the existing fire station requires some modifications, the existing fire truck should be supplemented by a modern foam truck and a rapid intervention vehicle.

Control Tower

It would be possible to modernize the existing control tower. AFL mini-panels and control desks should be installed and all equipment should be properly connected. No equipment rooms should be used as stores as they are now.

Miscellaneous Facilities

The airport should be properly fenced in, preferably by a chain-link fence. This safety measure is essential to stop people or animals from entering the airport area.

Passenger Terminal Building

The existing terminal building is close to the end of its economic life. Although it is in fair condition, the layout is completely inefficient and would seriously hamper future domestic operations. Even major reconstruction would not provide for future efficient, fast, and comfortable handling of passengers required for a domestic air transport network.

A small, modern, and efficient terminal building should be constructed along the apron edge. The size of the building should be adequate initially to handle 30 to 40 departing passengers and 30 to 40 arriving passengers within a short period with the usual passenger amenities. Additional space should be provided for people accompanying departing passengers or meeting arriving passengers.

Check-in counters, a waiting lounge, toilets, a baggage claim area, and airline offices should be included in the building design. No sophisticated equipment, such as conveyor belts, is required. With the rather extreme climatic conditions, the building should be provided with heating and cooling.

Instead of mechanized cooling, natural cross ventilation might be adequate, but since the windspeeds are normally very low, some air conditioning will be required.

A separate cargo building is not justified now but might be required later. In the design of the terminal building, a small space should be reserved for cargo handling.

With the town of A. Kamishli not far away and planned waiting times in the building limited, the provision of a restaurant seems justified only if the additional investment is compensated for by the fee paid by the concessionaire to DGCA. A small refreshment counter should be installed.

Altogether, a passenger terminal building of 700 to 900 square meters will be required in the first phase. The building should be designed so that it can be extended to accommodate future traffic.

For comparison, it should be mentioned that introduction of larger jet aircraft on the domestic network requires the construction of a more sophisticated building of about three times the capacity of the building proposed for turboprop aircraft.

It would be possible to reconstruct the existing building to house additional services and personnel. However, in view of the age of the building, a new office building should be constructed for the future.

Apron Services

Apron services can be limited, with stopover times of 10 to 15 minutes only. Efficient handling of passenger baggage is required, as are more trained personnel and more baggage carts.

The provision of fuel might not be economically feasible, but this is mainly a matter for the oil company to decide upon.

Maintenance

Based on the results of the maintenance system study recommended in the discussion on Aleppo Airport, an adequate system of facility maintenance should be established.

Investment Recommendations

Under the assumptions of converting domestic flight equipment to a turboprop type of equipment, and considering the traffic forecasts presented in Chapter A-3, the investment schedule through 1985 has been prepared as shown in Table A-5.11. Priorities suggested are:

1. Strengthening pavements.
2. Constructing a new terminal building.
3. Relocating and constructing a new apron.
4. Two-bar VASIS.
5. Airfield lighting.

Table A-5.11

INVESTMENT SCHEDULE AL KAMISHLI AIRPORT

(1980 prices)

Through 1985	Equipment Cost (000)	Installation Cost (000)	Import Duties (000)	Total Cost (000)
New Terminal Building				4,800
Overlay on 1750 m runway 8 cm 40,000m^2 4SP/cm/m^2				1,920
Construction New Apron & Taxiway 10,000m^2 @ 250SP/m^2				2,500
APL	2,000	800	180	2,980
VASIS	280	200	80	560
NDB (Relocation)		30		30
Utilities	300	100	90	490
Fence	360	140	110	610
Fire & Rescue Station				1,000
1 Fire Tender	700		210	910
1 Rapid Intervention Vehicle	300		90	390
Miscellaneous				1,010
Contingencies				2,580
Total				19,780

Source: Consultants' estimates

A-5.6 PALMYRA AIRPORT

Recommendations

Pavement

The F-27 aircraft recommended for domestic service require an LCN 14 on flexible pavements and an LCN 16 on rigid pavements. This is considerably below the existing pavement LCN; the application of an overlay is not required.

This type of aircraft does not require a longer runway at Palmyra. Compensated for aerodrome altitude and temperature, the F-27 aircraft would require a balanced field length of 1,350 meters. Although civil aircraft require only a short runway, military operations need the full length of 2,880 meters. It would be impractical to limit the civil part to 1,750 meters only. Because the long runway already exists and does not require major investments, use of the entire length enables closure of the runway for repairs and maintenance without a closure of the entire runway. Future use of the long runway by larger charter aircraft remains an open question, but more than incidental operations by such aircraft would require strengthening the pavements.

The size of the new apron under construction permits two aircraft of the F-27 type to be parked simultaneously. No enlargement is required.

Visual and Nonvisual Aids

Data on horizontal and vertical visibility at Palmyra Airport were collected from the records of the Meteorological Department and processed. On the basis of hourly observations during the years 1975 through 1979, the frequency of concurrent occurrence of a reduced horizontal visibility and/or low cloud base with a particular wind direction and wind speed was determined. Sophisticated approach aids are not required at Palmyra Airport.

In order to enable the domestic airline to maintain a proper schedule with high frequencies, night operations should be provided for. For that purpose, an airfield lighting system in accordance with ICAO Annex 14 for nonprecision instrument runways should be installed. This AFL system is also an advantage when there is a low cloud base or reduced visibility.

A firm requirement is the installation of VASIS on both thresholds to give pilots a proper indication of the correct glide path. Because of the recommended type of aircraft, two-bar VASIS will cover all requirements for the near future.

Other parts of the recommended AFL system are high-intensity elevated runway-edge lighting, with threshold and runway end lights; simple approach lighting systems on both thresholds for directional, distance, and roll guidance; taxiway and apron edge lighting; limited apron flood lighting; and an aerodrome rotating beacon.

All essential systems should be divided into two independent circuits for safety reasons.

The installation of a simple approach lighting system on a shortened runway would have required the installation of expensive flush inset light fittings, as would have been required for threshold and runway end lights. The additional lighting costs for the longer runway are partly compensated for by the avoidance of these more expensive flush fittings.

The existing old, obsolete NDB should be replaced by new solid-state equipment. This equipment may be used for nonprecision approach procedures.

All pavements should be provided with daylight markings in accordance with ICAO Annex 14.

Utilities

Since no power supply to the airport exists, a high-tension line should be installed between the town, the AFL equipment room, and the terminal area. Additional emergency power generators are required, with devices for automatic switch-over within 15 seconds.

Water supply from the town should be provided, or an airport well should be bored.

A telephone connection should be installed, as should a teletypewriter connection for use by DGCA and Syrianair.

A sewage system with septic tanks is required.

Fire and Rescue Services

Fire protection in accordance with ICAO category 4 must be provided. This requires the construction of a five-bay fire station and the acquisition of a rapid intervention vehicle, two water/foam tenders, and an ambulance.

Control Tower

Although a new tower has been built recently, the location and height is unsatisfactory. Preference should be given to a loca-

tion near the civil aviation area, together with the AFL equipment room and the radio equipment room.

However, since ATC services are a joint responsibility with the military at the airport, this should be discussed with the military authorities. Radio equipment should be installed.

Miscellaneous Facilities

Although the airport is provided with a barbed wire fence, it should be replaced by a better-protecting chain-link fence.

Grading of the strip area and terminal area should be improved, and the requirement of a guard dam between the military area and the runway against flooding of the latter facility should be investigated.

Passenger Terminal Building

A small, modern, and efficient new terminal building is sited along the apron edge. The size of the building should be adequate to handle 40 departing and 40 arriving passengers, with all accomodations required by the passengers. Additional space should be provided for people accompanying departing passengers.

The building should be provided with heating and cooling (natural or artificial), a waiting lounge, and toilets.

The building should be able to be expanded to accommodate future development.

Although the town of Palmyra is not far away from the airport and planned waiting times in the airport building are limited, the provision of a restaurant may be justified because at present the facilities for tourists in Palmyra are very limited. The feasibility of such a facility depends on the future availability of other restaurants in the area. In any case, the additional investment should be compensated for by the fee paid by the concessionaire to DGCA. A small refreshment counter should be provided.

For comparison, it should be mentioned that introduction of larger jet aircraft on the domestic network would require the construction of a more sophisticated building of about three times the capacity of the building now proposed.

A standard building design for Deir Ez Zor, Al Kamishli, and Palmyra would be an efficient move.

A separate cargo building is not justified through 1985 but might be required later if demand for air cargo transport

develops. The design of the terminal building should include a small space for cargo handling.

A number of offices for the airport staff and the airline operator should be provided, either in a separate office building or in the terminal building.

Apron Services

Apron services can be limited, with the stopover services of only 10 to 15 minutes. More trained personnel and more baggage carts will be required.

The provision of fuel might not be economically feasible, but this is mainly a matter for the oil company to decide upon.

Maintenance

Based on the results of the maintenance system study recommended in the discussion on Aleppo Airport, an adequate system of facility maintenance should be established.

Investment Recommendations

Investment recommendations for Palmyra Airport through 1985 are presented in Table A-5.12.

Suggested priorities are:

1. VASIS.
2. Fire and rescue equipment.
3. Airfield lighting.
4. Miscellaneous.

Table A-5.12

INVESTMENT SCHEDULE PALMYRA AIRPORT

(1980 prices)

Through 1985	Equipment Cost (000)	Installation Cost (000)	Import Duties (000)	Total Cost (000)
New Terminal Building	NR	NR	NR	4,800
AFL	2,200	890	660	3,750
VASIS	280	200	80	560
NDB Relocation	NR	30	NR	30
Fence	500	200	150	850
Utilities	800	260	240	1,300
Communications	1,000	NR	300	1,300
Fire and Rescue Station	NR	NR	NR	1,000
2 Fire Tenders	1,400	NR	420	1,820
1 Rapid Intervention Vehicle	300	NR	90	390
Miscellaneous Contingencies	NR	NR	NR	1,000
				2,530
		Total		19,330

CHAPTER A-6

ECONOMIC ANALYSIS OF AIRWAYS SYSTEM

Chapter A-6

ECONOMIC ANALYSIS OF AIRWAYS SYSTEM

INTRODUCTION

Formal economic analysis of expansion and improvement of the Syrian airport and airways system is at best an imprecise exercise based on forecasts and assumptions that are themselves impossible to accurately quantify. Chapter B will discuss the difficulty of developing domestic air passenger forecasts. These weaknesses should be fully appreciated in using the analysis that follows. Nevertheless, an analysis as rigorous as possible within these limitations is better than none at all and can at least give an indication of the viability of the proposed investments or the amount of public subsidy involved.

The investment program outlined in the foregoing chapters is essentially based on and divided between international and domestic facilities. A large proportion is for international facilities at Damascus and Aleppo that is already committed. A calculation of economic justification for the uncommitted investment has not been undertaken for two reasons. First, a large proportion is for safety and navigation equipment for which formal economic justification is not relevant, and second, a large proportion of investment will not be necessary until after 1985. Justification for this should be part of the analysis that has been recommended. The domestic part of the investment, however, can more readily be subjected to economic analysis in that major expenditures are predicated on new traffic generation.

METHODOLOGY

In Chapter B-3 there is a discussion of time savings that lends support to the traffic forecasts by indicating that there is substantial potential for domestic air traffic demand based on value of time, even when air fares are substantially increased. Supporting facilities have been recommended on the basis of this forecast.

Benefit calculations based on time savings are difficult to calculate and measure specifically for airport facilities for two reasons. First, the proposed facilities for the domestic service are essential even to get a reliable operation started. It might be agreed that a substantial share of benefits should accrue to the infrastructure. At the same time, the benefits have to be shared with the airline operator, who must pay for

service. Thus, the calculation will be highly arbitrary and ultimately controversial. Another methodology for calculating benefits, which is perhaps not as theoretically rigorous but is subject to fewer arbitrary assumptions, is to assume a user charge as a proxy for payment for benefits. In other words, financial analysis is used as a substitute for economic analysis.

Currently, no charges are levied for aircraft on domestic flights, but an improved, reliable domestic air system would justify user charges. In order to avoid the problem of how much an operator and how much a passenger should pay, a total revenue per passenger has been assumed. Thus, the analysis does not assume a specific tariff for passengers and aircraft, although the following section discusses this briefly.

PASSENGER FORECASTS

Passenger forecasts for domestic air services by route are developed in detail in Chapter B-3 (Table B-4.3). These forecasts have been used to develop the revenue accruing to the domestic airways system.

CAPITAL COSTS

The initial calculation of capital costs has been made on the basis of an investment program designed for use with F-27 aircraft. As the aircraft analysis indicates that a B 737 or similar fleet may be more appropriate, the capital will increase correspondingly.[1] The domestic portion of the overall airways investment plan has been isolated for the analysis for Damascus and Aleppo; most of the new expenditure is required for the international services. More has been allocated to domestic services, except in the case of Damascus, where a separate terminal is recommended after 1985. All expenditures on the smaller airports, including those for safety and navigation equipment, have been allocated to the domestic service. The schedule of domestic air service investments is shown in Table A-6.1.

OPERATION AND MAINTENANCE COSTS

Very little detailed information on the current operating and maintenance costs is available for the DGCA except for overall

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[1]See estimates for additional investment required (Chapter A-5) to switch over from F-27s to B 737s.

Table A-6.1

SCHEDULE OF CAPITAL EXPENDITURES

RELATED TO DOMESTIC AIR SERVICE

Damascus	SP (000)
1980 - 1985	-
1986 - 2000 (Domestic Terminal 1990)	15,000
Aleppo	
1980 - 1985	-
1986 - 2000	-
Other Airports	
1980 - 1985	87,260
Total	102,260

Source: Table A-1.2.

country totals. A summary of total costs and passengers is shown in Table A-6.2. Current operating expenses for all traffic are about SP 14.75 per passenger. One feature of the table that should be noted is the decline in average per passenger cost when volume increases. This trend is to be expected, as most expenses are fixed over a certain range of volume. Two cases were calculated. First the current SP 14.75 per passenger cost was assumed to drop to SP 12.00 per passenger in 1985 and to be constant thereafter. In the second case, costs per passenger were assumed to drop further to SP 10.00 in 1990 and SP 8.00 in 199 .

REVENUES

Two revenue cases have been calculated for comparative purposes. One assumes a constant revenue throughout the 20 year period nearly equal to the present average operating cost of SP 15.00 per passenger. The second case assumes a relative increase in revenue to SP 17.50 in 1985 and SP 20.00 in 1990. The latter case would reflect the fact that increases in real income will increase the ability to pay user charges.

RESULTS OF ANALYSIS

The results of the analysis are summarized in Table A-6.3 and are shown in detail in Table A-6.4. It is clear from the results that using the methodology outlined previously, investment in the domestic airways facilities is not economically justified. Even under generous assumptions of rising per unit revenues and falling per unit costs, and with a lower discount rate, benefits as measured by user fees do not nearly cover capital costs. These results suggest two things, either that the assumed rates of user fees are too low or that a significant element of subsidy will have to be involved if a domestic air service is to be expanded. Based on a comparison of income levels and likely air fares, there is little flexibility in setting user fees significantly above the assumed levels. An example using the data in Chapter B-3 will illustrate this point.

A senior Government executive's salary may average SP 13.00 per hour. If he has to make a trip to Aleppo to do business, he can do this in one day if good air service is available, saving about nine hours in total. Thus, his total value of time saved would be at least one working day (if he had to drive and work in Aleppo, he might have to stay overnight at additional expense). However, if he saves nine hours and values his time at close to his hourly rate, the value of time saved would be

about SP 117. For this he must pay air fares and airport taxes. At present air fares and bus fares, the extra cost would be about SP 50.00, and as already pointed out, air fares should probably be higher to be economic. If he pays an airport fee of SP 15 at each end of the trip, his total extra cost would be SP 80, leaving just SP 37 as an overall saving. Thus, substantially higher user charges for air facilities on this route would eliminate the time cost advantages for using air service.

USER CHARGE TARIFF STRUCTURE

The previous section indicates that it is unlikely that user charges could recover costs of air service infrastructure in the domestic air network. The levels of charges set will depend on the quality of facilities provided and the level of subsidy the Government feels is justified. In general, however, a substantial subsidy level will be necessary until traffic builds. Apart from the subsidy question is the question of how the tariff should be structured. There are several alternatives varying from hidden cost recovery through air fares to direct payment by passengers. Each alternative has certain advantages and disadvantages, but possibly the easiest system to administer in Syria would be to include the airport charges as part of the ticket price. This system would avoid the problems and inconveniences to passengers of having to purchase airport tax tickets each time they use an airport terminal. It will also avoid theoretical problems and arguments regarding how much aircraft should pay and how much air passengers should pay. Thus, a simple addition of a single charge to the ticket price of, say, SP 20 or 25 to cover a round trip would be a simple, easily administered solution. The single one-level charge on domestic flights is suggested because most infrastructure costs are not related to distance but to usage by a passenger and probably one type of aircraft. Thus, there is no need to set a scale of charges for different types of aircraft or for passengers travelling different distances.

Of course, other sources of revenue should also be considered, but these will involve non-flight-related items such as concessions for food and beverages, parking, and office space. A separate charge for noncommercial aircraft might also be considered, although airfield services are usually provided free of charge, as they are at the present time.

Table A-6.2

DIRECTOR GENERAL OF CIVIL AVIATION

SUMMARY OF OPERATING EXPENSES

(000)

Operating Expenses	1975	1976	1977	1978	1979
Salaries	4,809	5,474	NA	NA	8,492
Other Expenses	6,076	5,975	NA	NA	6,052
Total	10,885	11,449	13,220	14,458[2]	14,544[2]
Total Air Passengers[1] (000)	652	950	824	992	986
Operating Expense per passenger	16.69	12.05	16.04	14.57	14.75

Source: Directorate General of Civil Aviation - Planning.

[1] Includes domestic and international.

[2] Budgeted expenses.

Table A-6.3

DOMESTIC AIR FACILITIES

SUMMARY OF ECONOMIC RESULTS

	Present Value	
	12%	5%
Case A		
PV of Capital Costs	79,279	90,606
PV of Net Revenues	4,419	10,048
Case B		
PV of Capital Costs	79,279	90,606
PV of Net Revenues	13,340	32,954

Case A

Revenues constant at	SP 15.00/pax	in 1985
Costs fall to	SP 12.00/pax	1985

Case B

Revenues rise to	SP 17.50/pax	1985
	20.00/pax	1990
Costs fall to	12.00/pax	1985
	10.00/pax	1990
	8.00/pax	1995

Table A-6.4

DOMESTIC AIRWAYS SYSTEM BENEFITS AND COSTS

	CASE A				CASE B				
Year	Capital Cost	Operating and Maintenance Cost	Revenues	Net Revenues Cost	Capital Cost	Operating and Maintenance Cost	Revenues	Net Revenues Cost	Total
1980	21,800	958	975	17	21,800	958	975	17	65
1981	21,800	1,165	1,185	20	21,800	1,165	1,185	20	79
1982	21,800	1,416	1,440	24	21,800	1,416	1,440	24	96
1983	21,800	1,741	1,770	29	21,800	1,741	1,770	29	118
1984		2,109	2,145	36		2,109	2,145	36	143
1985		2,100	2,625	525		2,100	3,063	963	175
1986		2,321	2,901	580		2,321	3,378	1,057	193
1987		2,565	3,206	641		2,565	3,745	1,180	214
1988		2,835	3,544	709		2,835	4,130	1,295	236
1989	7,500	3,133	3,916	783	7,500	3,133	4,568	1,435	261
1990	7,500	3,463	4,328	865	7,500	2,890	5,780	2,890	289
1991		3,827	4,784	957		3,190	6,380	3,190	319
1992		4,230	5,287	1,057		3,520	7,051	3,531	352
1993		4,675	5,843	1,168		3,900	7,793	3,893	390
1994		5,166	6,458	1,292		4,310	8,613	4,303	431
1995		5,710	7,137	1,427		3,808	9,519	5,711	476
1996		6,311	7,888	1,577		4,206	10,520	6,314	526
1997		6,974	8,718	1,744		4,646	11,627	6,981	581
1998		7,708	9,635	1,927		5,136	12,850	7,714	642
1999		8,519	10,649	1,130		5,680	14,202	8,522	710
2000		9,415	11,769	2,354		6,272	15,696	9,424	784

Present Value	
Capital Cost	79,279
PV Net Revenues	4,419

Case A: Revenues constant @ SP 15.00/pax

Case B: Revenues rise from SP 15.00/pax in 1980 to SP 17.50 in 1985 and SP 20.00 in 1990
Costs drop to 12.00/pax 1985 10.00 1990 8.00 1995.

CHAPTER B-1

SUMMARY AND RECOMMENDATIONS

Chapter B-1

SUMMARY AND RECOMMENDATIONS

FINANCE AND ACCOUNTING

The accounts of Syrianair are such that it is impossible to determine profitability by routing whether revenues from international flights are cross-subsidizing domestic flights or the extent to which the airline is being subsidized by the Syrian Government. Balance sheets are two to three years behind schedule. A recognized accounting firm should be engaged to set up accounting procedures and practices that are followed by most international airlines.

DOMESTIC AIRCRAFT TYPE

The Caravelle aircraft now in service are expensive to operate and should be replaced with turboprop aircraft such as the F-27 to provide efficient, regular, and more frequent services for city pair routes where domestic airports are located.

An initial fleet of three aircraft with seating capacitys of 30 to 40 passengers could serve the traffic projected through 1985.

INTERNATIONAL AIRCRAFT TYPE

The international route structure of Syrianair is ill-suited for the two B 747 SP aircraft since they are especially designed for very long routes. Unless Syrianair plans to extend its routes to, say, New York or Bangkok, these aircraft should be traded or sold and replaced by B 727 medium-range aircraft.

Our recommendations are that the B 747 SPs be replaced with two new B 727 200s, each costing $14 million for the aircraft alone; that the three new F-27s be purchased for the domestic service at a cost of $5 million each; and that two new aircraft be purchased to meet the projected increase in international passenger demand and to replace the Caravelle in international service. We have used an airbus/B 767 type aircraft for costing the investment in additional aircraft, but the exact aircraft to be selected must be based on a detailed feasibility study.

For the period 1986-2000, six additional aircraft will be needed for the international service, and two B 737 type aircraft will be required as domestic demand expands. These investments are reflected in the financial analyses in Chapter B-5.

Used B 727 200s are available in the international market. Prices vary widely with age, condition, and configuration. International aircraft brokers quoted prices as low as $2 million and as high as $5 million. The Consultants were unable to get a price quote for a used F-27.

The Consultants also looked into the possibility of leasing these aircraft, they found no aircraft broker prepared to give quotations because of the myriad different conditions and approaches in the aircraft leasing business. However, such leases can be negotiated in specific instances.

TRAINING

More intensive attention must be given to employees below top technical and professional positions. Training of such paraprofessional employees should be reoriented and strengthened.

Immediate attention should be given to development of a Syrianair Training Center, which would ideally be located near Damascus International Airport. A proposed terms of reference for the center is presented and discussed in this chapter.

Damascus International Airport Services for Handling Aircraft, Passengers, and Cargo

Ground-handling services performed by Syrianair for foreign airlines under contract are well below international standards. Either Syrianair must improve its ground-handling equipment and provide better trained personnel who are more responsive to passenger needs and cargo handling, or consideration should be given to forming a private ground-handling company to perform these services under contract.

RECOMMENDED INVESTMENTS FOR SYRIANAIR

Table B-1.1 summarizes the investments recommended by the Consultants for Syrianair for 1981-2000 with respect to purchase of new aircrafts and disposition of old aircrafts. Detailed analyses and discussions are presented in later chapters of this volume.

Table B-1.1

SYRIANAIR RECOMMENDED INVESTMENTS

(million SP)

	1981	1982	1983	1984	1985	Total
Replace B-747 SPs		125.6				125.6
Additional Aircraft for International Operations			314.0			314.0
Domestic Aircraft	67.3					67.3
Subtotal						506.9
Less:						
Sale of B-747 SPs		-376.0				-376.0
Sale of Super Caravelles			-7.0			- 7.0
Net Investment						123.9

PROBABLE LONG RUN INVESTMENTS

	1986-1990	1991-1995	1996-2000	Total
Additional Aircraft for International Operations	314.0	314.0	314.0	942.0
Additional Aircraft for Domestic Operations	66.7	-	66.7	133.4
TOTAL				1,075.4

Source: Consultants' estimates.

CHAPTER B-2

ESTABLISHMENT

Chapter B-2

ESTABLISHMENT

GENERAL

Syrianair began operations in 1947 with one DC-3 aircraft. Today, its fleet consists of two B 747 SP aircraft, four Caravelles, and three B 727 200s. Future plans are to further expand by ordering new aircraft and/or upgrading the Caravelles by replacing the obsolete engines with more efficient ones.

The staff of Syrianair has grown in parallel with its fleet. The company now has about 3,000 employees and is fully up to its authorized staffing ceiling.

The UNDP and the ICAO recently completed an in-depth study of Syrianair's organization and management titled, "Report on Organization and Management of Syrian Arab Airlines, February 1980." Except where noted below, the Consultants are in basic agreement with this document.

ORGANIZATION AND FUNCTIONS

Figure B-2.1 shows the legal organization of Syrianair. The following discussion will cover the major functions of each department and note where the de facto, or actual, organization differs from the legal entity. Where relevant, comments or specific recommendations are made based on the Consultants' overall appraisal of organization, management, and operations.

Syrianair policy, long-range plans, and overall guidance are now provided by a six-member board of directors. Since all of the board members are from inside Syrianair, the company is a closed operation with few opportunities for receiving valuable input of knowledge and experience from outside. In fact, the board acts more in the role of a management or executive committee without the benefit of external inputs to policies and guidance that could be expected from a broader-based board of directors with outside members.

It is recommended, therefore, that the Ministry of Transport (MOT) and Syrianair consider establishing a new board of directors and provide a charter for them. The present board should then become a management committee with responsibility for implementing board policies within the company.

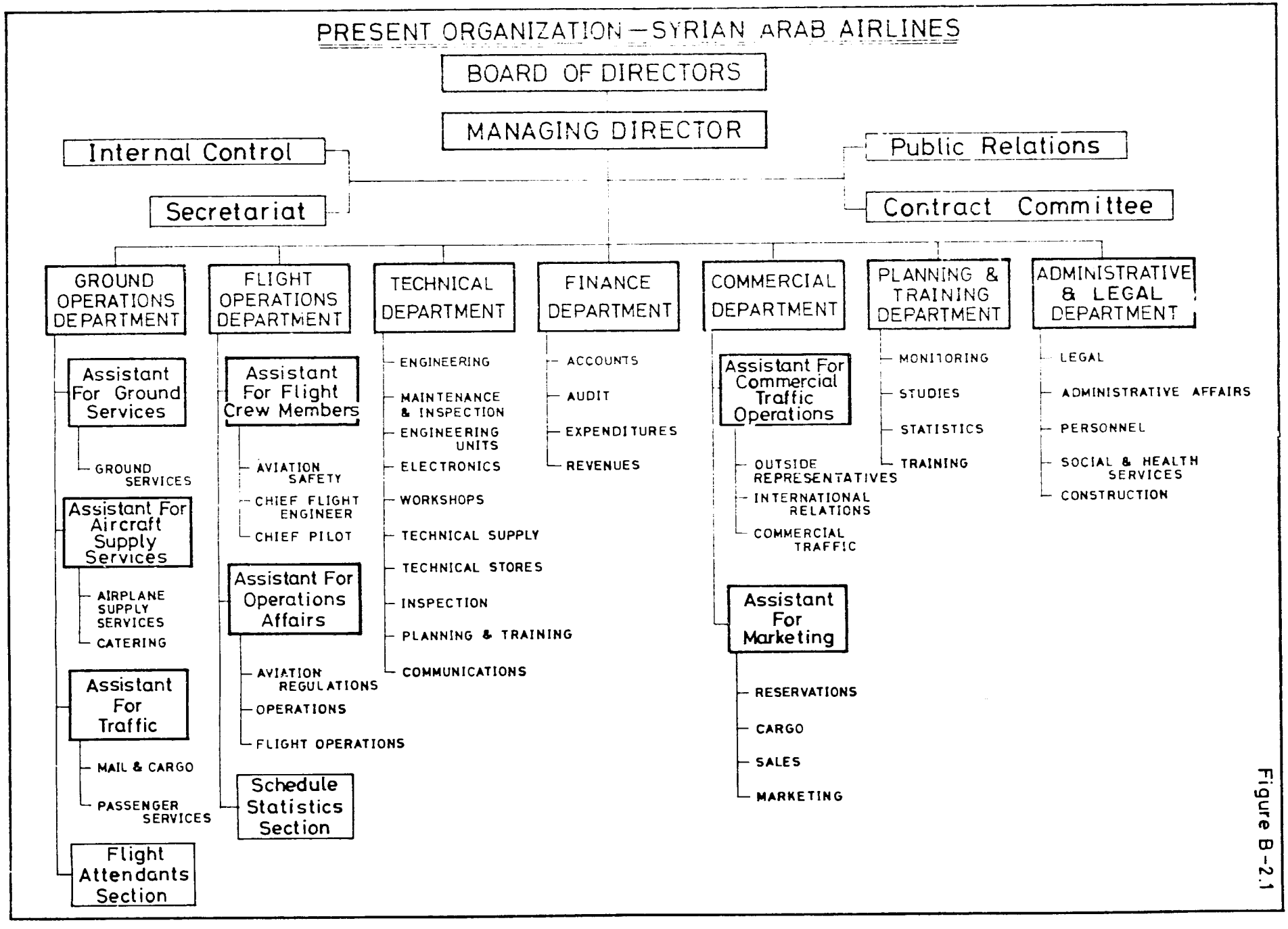
PRESENT ORGANIZATION — SYRIAN ARAB AIRLINES
BOARD OF DIRECTORS
MANAGING DIRECTOR
Internal Control
Secretariat
Public Relations
Contract Committee
GROUND OPERATIONS DEPARTMENT
Assistant For Ground Services
GROUND SERVICES
Assistant For Aircraft Supply Services
AIRPLANE SUPPLY SERVICES
CATERING
Assistant For Traffic
MAIL & CARGO
PASSENGER SERVICES
Flight Attendants Section
FLIGHT OPERATIONS DEPARTMENT
Assistant For Flight Crew Members
AVIATION SAFETY
CHIEF FLIGHT ENGINEER
CHIEF PILOT
Assistant For Operations Affairs
AVIATION REGULATIONS
OPERATIONS
FLIGHT OPERATIONS
Schedule Statistics Section
TECHNICAL DEPARTMENT
ENGINEERING
MAINTENANCE & INSPECTION
ENGINEERING UNITS
ELECTRONICS
WORKSHOPS
TECHNICAL SUPPLY
TECHNICAL STORES
INSPECTION
PLANNING & TRAINING
COMMUNICATIONS
FINANCE DEPARTMENT
ACCOUNTS
AUDIT
EXPENDITURES
REVENUES
COMMERCIAL DEPARTMENT
Assistant For Commercial Traffic Operations
OUTSIDE REPRESENTATIVES
INTERNATIONAL RELATIONS
COMMERCIAL TRAFFIC
Assistant For Marketing
RESERVATIONS
CARGO
SALES
MARKETING
PLANNING & TRAINING DEPARTMENT
MONITORING
STUDIES
STATISTICS
TRAINING
ADMINISTRATIVE & LEGAL DEPARTMENT
LEGAL
ADMINISTRATIVE AFFAIRS
PERSONNEL
SOCIAL & HEALTH SERVICES
CONSTRUCTION

Figure B-2.1

A suggested composition of the new board of directors, which would require a legislative decree, is:

- Managing Director (Chairman)
- Deputy Managing Director (Vice Chairman)
- MOT Air Affairs Bureau Head
- General Director of Civil Aviation
- Syrian Air Force
- Ministry of Tourism
- Ministry of Finance
- Aviation Policy Advisor
- Representative of employees

The major benefits of such an arrangement are that policy and guidance would be separated from day-to-day management and operations. Management, however, would have a strong voice in decisions regarding these policies. Syrianair executives in the line departments would be relieved of a difficult dual responsibility. They would concentrate on implementation of policies rather than on attempting to both develop and implement them. The Consultants believe that this will improve efficiency and contribute to the business orientation that Syrianair should have.

DEPUTY MANAGING DIRECTORS

Although Syrianair is authorized to have two deputy managing directors - one in charge of Technical Affairs (Technical, Flight, and Ground Operations), and one in charge of Administrative Affairs - at present, there is only one deputy managing director with a breadth of experience in both technical and administrative aspects of airline operations. The Consultants believe that one deputy director, if given adequate authority and responsibility for day-to-day operations, is sufficient based on the present size of Syrianair. This deputy should relieve the managing director of many operational problems so that he can concentrate more on long-range planning policies and growth decisions. As the airline expands, it will be important to review the need for adding the second deputy. In particular, increased domestic operations might result in adding a deputy for that alone.

ADMINISTRATIVE AND LEGAL DEPARTMENT

The UNDP/ICAO report previously noted suggests a reorganization of this department into nine sections under the control of two deputy department directors (one for personnel and one for administration). In addition, the report recommends the addition of a Central Manuals Division, an out-station assignments function, a separate section for recruitment, and a separate section for insurance.

This arrangement results in a desirable division of responsibilities between personnel related functions and administrative functions; however, it does greatly increase the number of sections reporting to the Director of Administration.

If in fact the recommended deputies are given line authority and full responsibilities for the sections under their direction, the Consultants endorse this UNDP/ICAO recommendation with the sole reservation of the present need for a separate Recruitment Section. At present the functions of this section should be handled by the manager of Personnel Administration.

In addition, the need for involving the Training Section of the Training and Planning Department in such matters as personnel recruitment, orientation, and training should be recognized as vital. This coordination was not noted in any of the descriptions of the expanded Administration Department in the UNDP/ICAO report. The Consultants also fully endorse the need for a formal manuals section in the Administrative Department. Syrianair is presently lacking in procedural and operational manuals for almost all departments. This lack is particularly critical in the Flight Operations and Technical Departments.

DEVELOPMENT

Training and Planning Department

The Duties of the Planning Section cover preparation of long and short term plans, including fleet size and route structure; investment and development plans; feasibility studies; and other related functions. The Training Section prepares training plans; determines manpower needs and develops training programs; and coordinates company-wide training activities.

The Consultants have discussed the Training Function in Chapter B-6. In general a broader range of authority and responsibility has been recommended for the Training Section. Primarily, it should be involved in coordinating all training; supporting through development of guidelines and training orders the departments, such as the Technical Department, who by necessity must do their own training; and evaluating training effectiveness. In addition they should be fully responsible for preparing an integrated long range training plan for the company. Finally, when Syrianair has a Training Center, the Training Section should be up-graded to department level and should administer this center.

Finance Department

The UNDP/ICAO report recommends that the Finance Department be divided into two major functional groupings, expenditures and

revenues audit and administration. Each of these two groupings would be under the management of a deputy director. The Consultants endorse this recommendation as being fundamental to modern financial management with its built-in checks and balances.

Commercial Department

The Commercial Department is delegated the functions associated with the promotion and sales of the company's services within the country and internationally. It is responsible for the development of programs to promote passenger, cargo, and charter services of Syrianair. A principal function is the establishment of a network of sales reservation offices, including outside travel agents, throughout the geographic areas serviced by the airline. The organization maintains liaison with travel agents and traffic managers to encourage the transport of tourist groups, passenger service, and cargo.

The UNDP/ICAO organization study proposes a division of the department into two major functional areas, namely Traffic and International Affairs and Marketing. Each major area would be under direct supervision of a deputy director. This is a logical division of authority and responsibility.

A separate training center or school for marketing, as proposed by UNDP/ICAO, is, however, not recommended. Such training should be an integral part of the overall Syrianair training program.

Technical Department

The UNDP/ICAO report proposes revising the Technical Department. The Consultants are in basic agreement with the proposal. In particular, the splitting of the inspection function from maintenance and giving it equal status with production is fundamental to ensure that it is effective. The deputy manager, however, is not shown in a role of direct line responsibility in the UNDP/ICAO report. The Consultants recommend that he be given line authority and responsibility to act over both production and provisioning. The need for two deputies for those functions is questionable until the Syrianair fleet expands further or begins to do more maintenance operations, such as repairing some components.

Flight Operations Department

This department is responsible for all functions pertinent to flight crew personnel and flight operations. This includes implementation of approved operational policies and safety regulations; preparation of flight crew schedules; training and testing of flight crews; flight testing of equipment; and maintenance of proper records and statistics on all operations.

The Consultants have reviewed the UNDP/ICAO report on this critical operation and fully endorse the proposed changes to the existing organization. One area of concern, however, is the lack of a centralized records and statistics function in the proposed changes. This function is part of the present organization. It should be included as a function in the Chief Pilot System proposed by UNDP/ICAO or in a user department such as planning.

Ground Operations Department

This department is responsible for all activities relevant to passenger services; loading and unloading of baggage, cargo, and mail; gate parking; and aircraft and station cleanliness and orderliness.

The present organization of this department does not show a clear delineation between what would be considered "station" functions (for example, Damascus and Deir Ez Zor) and "main office" functions common to all stations. This ambiguity, coupled with the inadequate existing airport, may be in part responsible for the low standards of ground-handling services noted elsewhere in this report. It is recommended that all station operations be separated from central operations and that a station manager at each station be given full responsibility for all services relating to passengers, cargo, and mail. It is understood that this department has just completed a reorganization study which has yet to be approved.

The UNDP/ICAO study recognizes the problem of divided responsibility and control at the airports and recommends such a division of operations. The Consultants are in basic agreement with the organization proposed in that report.

CHAPTER B-3

FLEET, FACILITIES, ROUTE STRUCTURE

Chapter B-3

FLEET, FACILITIES, ROUTE STRUCTURE

DOMESTIC

There are six airports in the domestic civil airport system in Syria which are capable of supporting air service to sections of the country for which feasibility can be demonstrated: Damascus International, Aleppo, Lattakia, Palmyra, Deir Ez Zor, and Al Kamishli. Neither Lattakia nor Palmyra has been provided with scheduled air service recently.

Frequency of Service

Syrianair currently schedules the following domestic services, principally in Caravelle aircraft:

Route	Weekly Round Trip Frequency	Total Weekly Seats
Damascus-Deir Ez Zor	5	435
Damascus-Aleppo	3	325
Damascus-Al Kamishli	2	174

However, this capacity is more apparent than real. For instance, one of the Aleppo schedules to and from Damascus is the B 727 flight between Damascus and Munich. Obviously the carrier would protect a major portion of the available seats for Munich passengers. Aleppo passengers would be carried largely on an "as available" basis. Damascus-Al Kamishli is a one-stop operation through Aleppo; accordingly, the seats carried to Al Kamishli are shared between Al Kamishli and Aleppo and must, therefore, be regarded as duplicated quantities.

Although the foregoing describes the service currently "scheduled" by Syrianair, no air service has in fact been provided to or from Aleppo since August 1979 and it is not likely to resume until after 1 January 1980. Aleppo has only a single runway, which is currently being repaved, and, therefore, all airplane operation has been suspended. A similar airport closure for approximately four months was ordered at Aleppo in 1976 for runway maintenance.

Regardless of the level of demand or the quality of service, no short-haul air transportation service can be promoted and sustained with such arbitrary and protracted service suspensions. By contrast, Karnak provides hourly bus service in both directions.

Service between Al Kamishli and Damascus is currently scheduled twice a week. A person flying to Al Kamishli on Saturday cannot anticipate a return flight to Damascus until Thursday. Accordingly, a one-day business or tourist visit requires at least one full additional day of surface travel in order to avoid the delay awaiting the return flight. Moreover, flight cancellation rates ran as high as 40 percent per month in 1979, substantially increasing public exposure to large waiting delays. In light of the fact that surface transportation involves between 13 and 15 hours of travel plus possible bus change delays, short-term travel in this city-pair market faces almost prohibitive constraints.

Admittedly, the Damascus-Al Kamishli schedule is a poor example; however, it serves to dramatize a condition which significantly affects short-haul air transportation generally: the shorter the haul, the more critical is frequency of service. All of the airports in the domestic airport system should be provided with at least twice-daily schedules - ideally, one early morning and one late afternoon arrival and departure each, in order to exploit fully the air travel segment of intercity transportation demand. To the extent that this or greater frequency cannot be assured, waiting time must be added to travel time in assessing public acceptance of short-haul air service. Furthermore, to the extent that adequate high-speed intercity service is denied, the objective of stimulating a greater commercial/industrial development throughout Syria will be compromised.

Distances Between City Pairs

As is indicated in Table B-3.1, the airway distances between these points are generally shorter than road distances, in some instances by a considerable margin. In the one major exception, Damascus-Palmyra, where the road distance is substantially less, the airways distance could be shortened if a re-allocation of airspace between civil and military users were practicable. For instance, the airways distance of 328 kilometers via Tanf could be reduced to 233 kilometers if a new airway were oriented directly between the Damascus VOR and the Palmyra NDB. If this were to happen, the airway distance would be approximately the same or slightly shorter than the new direct highway between Damascus and Palmyra. By extending this reoriented airway over Palmyra or Deir Ez Zor, the airways distance between Damascus and Deir Ez Zor would be reduced from 450 kilometers to 404 kilometers and the distance between Damascus and Al Kamishli reduced from 777 kilometers to 617 kilometers. Similarly, the airway between Damascus and Aleppo is currently oriented over Kariatain, which increases the flight distance 13 percent. By straightening this airway, the distance can be reduced

from 367 kilometers to 324 kilometers with corresponding improvements in the cost of the service and travel time; the airways distance between Damascus and Lattakia would be reduced from 340 kilometers to 283 kilometers.

Fares

Both surface and air transport services are heavily subsidized and/or regulated by the Syrian Government. In the case of air service by Syrianair and bus service by Karnak, the service is sold to the public at less than operating cost. In the case of taxi and microbus service, the tariffs are prescribed by regulation. In all cases, transportation benefits from indirect subsidy primarily in the form of fuel prices which are substantially below economic cost and, indeed, well below international prices. Passenger fares by surface and air are shown in Table B-3.2

Travel Time

The average time required to travel between these city pairs is described in hours and minutes in Table B-3.3.

To derive total time en route, it would be necessary to add local travel time to and from the terminals concerned and terminal processing time. This will require approximately one hour and 15 minutes additional time for air service, 45 minutes for bus or taxi and zero time for private car. However, in the case of bus service to Al Kamishli, at least one bus change is required en route with a consequential delay of an estimated 45 minutes plus en route stops, which are estimated to total an additional 30 minutes each. In the case of air service between Damascus and Al Kamishli, the current schedule includes a stop at Aleppo, which adds 50 minutes to the total en route time.

Load Factors

Passenger load factors in domestic air services have been maintained at an extraordinarily high level during recent years. In 1977, 67.8 percent of the Caravelle seats offered in domestic services were filled; in 1978, the load factor had increased to 76.4 percent; in the first four months of 1979 domestic load factors averaged 85.4 percent.

This performance stands in sharp contrast to the load factors generated in Syrianair international operations in the Caravelle which, in one region in the first four months of 1979, averaged 32.3 percent. Load factors in all international operations in Caravelle aircraft averaged 52.4 percent, while in the total international operations, including also B 727 and B 747 aircraft, load factors averaged 51.0 percent. No segment of

Syrianair's international services performed so consistently at such high levels of aircraft occupancy as its domestic service.

No data exist concerning the number of prospective airline passengers who were denied reservations because of completely booked flights in Syrianair. However, the experience in other airlines in which these data have been recorded indicates that, at load factors of this magnitude, approximately 30 percent of all flights would have bookings rejected. Indeed, during four of the 12 segment-months within this period, load factors ranged between 92 percent and 95 percent; on these segments almost half of all flights would have rejected prospective passengers, in many instances in large numbers. Furthermore, since the carrier does not have a reservation computer system, no reservations will be accepted at all for certain stations, such as Deir Ez Zor, except at the originating station. In other words, a confirmed round trip reservation DAM-DEZ-DAM cannot be made. With so high an occurrence of passenger rejections, a regular clientele cannot be promoted successfully.

This record clearly suggests that capacity is needed to properly serve demand on domestic flight segments. As previously noted, this increased frequency will itself stimulate a substantial increase in the demand level. The strong demand level which currently exists gives support to the contention that income levels will support a substantial enlargement of domestic air travel services. Tables B-3.4 and B-3.5 present basic domestic passenger and load factor statistics.

Aircraft Type

Until 1972, Syrianair domestic services were provided in DC-4 and DC-6B aircraft. During the five years preceding 1972, domestic service, measured in ton-kilometers performed, increased 485 percent for an average annual increase of 55 percent. In 1972 the Super Caravelle was introduced into domestic service, and during the subsequent five years, the total domestic service declined from 2.69 million ton-kilometers per year to 1.05 ton-kilometers - a decline of 61 percent. Aircraft-kilometers in domestic service in 1976 declined 71 percent from the level of service provided in 1971. The decline in ton-kilometers and aircraft-kilometers was accompanied by a corresponding decline in frequency of service.

Since 1976, seat-kilometers in domestic operations have increased to a current annual rate of 30.6 million, which is still 31 percent below the 1971 peak year. Of even greater significance is the fact that service frequency is still 59 per-

Table B-3.1

DISTANCE BETWEEN CITY PAIRS

Route	Existing Airways Distances (Kms)	Potential Airways Distances (Kms)	Road Distances (Kms)	Rail Distances (Kms)
DAM-DEZ	450	404	691	743
DAM-ALP	367	324	355	403
DAM-KAC	777	617	950	960
DAM-PLR	328	233	240	290
DAM-LTK	340	283	348	403

Table B-3.2

PASSENGER FARES - ONE WAY

To/From	Aleppo	Lattakia	Palmyra	Deir Ez Zor	Al Kamishli
Damascus					
Microbus	10.60	11.25	11.25	20.75	28.50
Karnak	15.50	15.50	15.50	31.10	43.70
Taxi	16.50	16.50	15.00	32.50	44.65
Rail 2nd Cl.	15.00	NA	NA	21.00	27.00
Rail 1st Cl.	22.50	NA	NA	31.50	40.50
Airline	40.00	NA	NA	60.00	100.00
Private Car[1]	198.00	183.60	177.00	373.00	513.00

[1] Vehicle cost.

Source: Volume IV, Appendix 6.2, Final Phase I Report

Table B-3.3

TRAVEL TIME

Route	Microbus	Car and Express Bus	Rail	Air
DAM-ALP	6.62	5.45	5.00	0.45
DAM-LTK	8.07	6.75	-	0.40
DAM-PLR	3.48	3.15	3.45	0.40
DAM-DEZ	13.56	11.30	10.00	0.50

Source: Volume IV, Appendix 6.6, Final Phase I Report

Table B-3.4

ONE-WAY PASSENGER MOVEMENTS - 1979

	DAM-ALP	DAM-LTK	DAM-DEZ	DAM-KAC	ALP-KAC	ALP-DEZ
Road	1,116,000	525,000	35,000	161,000	432,500	295,000
Rail	-	-	-	-	109,000	78,000
Air	5,076	1,365	15,507	4,197	2,997	-
Total	1,121,076	526,365	50,507	165,197	544,497	373,000
% Air	0.45	0.026	30.7	2.50	0.55	-

Table B-3.5

SYRIAN ARAB AIRLINES TRAFFIC - DOMESTIC SERVICE

	Seat-Kms (000,000)	Passenger-Kms (000,000)	Load Factor %	Passengers (000)
1967	NA	5.2	NA	11.4
1968	NA	7.8	NA	17.0
1969	NA	24.3	NA	53.1
1970	NA	27.3	NA	59.7
1971	44.5	30.4	68.3	66.4
1972	32.5	23.7	72.9	51.6
1973	28.2	16.0	56.7	34.6
1974	21.1	15.1	71.2	35.8
1975	23.8	17.7	74.4	52.8
1976	23.1	12.5	54.1	29.0
1977	32.4	19.3	59.6	52.1
1978	38.5	29.4	76.4	62.5
1979[1]	30.6	25.4	83.0	58.0

Note: NA = Not available.

Annual rate based on first four months.

cent below the 1971 peak. Of course, at the domestic airports in Syria there is no other aviation option to fill the void created by these frequency reductions - neither foreign services nor any other domestic operations, private or public, are available. Providing a reliable domestic service over the longer term would require careful consideration of aircraft suitability. There are a number of possibilities, including using the present Caravelles, replacing these relatively high operating cost aircrafts with new jets with a similar capacity to the Caravelle, or replacing Caravelles with smaller turbo prop aircraft such as the F-27. While the F-27 was chosen for analysis purposes, the decision regarding the specific aircraft to be purchased should be based on a full feasibility study.

The first consideration is the appropriateness of the aircraft for the route and traffic. In order to avoid undue loss of ride comfort in turbine propeller airplanes, preference should be given aircraft of fairly high wing loading. Such aircraft are generally less sensitive to crosswinds in landing as well, which is particularly significant in view of the prevalence in Syria of one-runway airports. Although such a design may require somewhat longer than average landing distances, none of the candidate types will encounter landing distance problems at any of the domestic airports. Table B-3.6 gives Syrianair aircraft fleet operated from 1967 to the present on all routes. Using the forecast annual figures in Table B-4.3, Chapter B-4, for each city pair, a rough daily demand was calculated.

Our analysis of both annual and daily demand by city pair shows clearly that for most routes, except Damascus-Aleppo and Damascus-Deir Ez Zor, the average two-way traffic will be below 75 passengers per day, or less than 40 each way, in 1985. This indicates that the present Caravelle or a replacement jet such as a DC-9-30 or B 737 have too much seating capacity for such routes. Even Damascus-Aleppo and Damascus-Deir Ez Zor with about 120 passengers (60 each way) could be served by smaller aircraft with greater frequency. On all routes, frequency of service is an important consideration. Using jets for more than once-a-day service would be expensive. For example, on the Damascus-Lattakia route, about 40 passengers per day each way are forecast in 1985. One service a day by a 100-seat B 737 would have a load factor of only 40 percent; with twice-a-day service, it would be 20 percent, clearly an uneconomic level as the cost would be about 74 piasters per passenger-kilometer (Table B-3.7).

With an F-27, on the other hand, twice-a-day service could be provided with a 40 percent load factor and a cost of 69 piasters per passenger kilometer. Table B-3.8 shows the seat-kilometers provided over a possible eight route network. The 100-seat aircraft provides as many seat miles on one round

trip as the smaller aircraft does on two trips, but this is clearly not an advantage unless passengers are available to fill those seats.

Cost Comparison

Two aircraft have been compared for cost purposes at varying load factors, the B 737 and F-27. The B 737 is assumed to have 100 seats and the F-27 50 seats. U.S. operating experience has been used for comparison purposes. While Syrian cost levels will not be identical, the relative levels between aircraft should be similar. To update the 1978 data in order to provide a more valid comparison, fuel and depreciation adjustments were made to the U.S. statistics. The results of the cost comparison are shown in Table B-3.7. The fuel cost adjustment makes a significant difference in relative cost levels between the two aircraft types because of the relative fuel efficiency of the turboprop aircraft.

In 1978 fuel cost was 18 percent of direct operating cost per block hour for the F-27 and 42 percent for the B 737. But with adjustment of fuel to reflect recent price rises, the proportion of fuels rises to 28 percent and 53 percent respectively. Table B-3.7 shows that the F-27 is less expensive per passenger-kilometer throughout the effective capacity range of the F-27. At larger loads the B 737 becomes cheaper than operating more frequent F-27 service. At a 70 percent load factor (70 seats), the B 737 is about one-half the cost per passenger-kilometer of operating two F-27s at a 70 percent load.

Jet Phase-In for Domestic Routes

A route-by-route analysis was carried out to determine approximately when jet service would be justified. It was assumed that a switch to jets would be made as soon as two services per day at a 50 percent jet load factor could be achieved. This load factor level is supported by the cost data in Table B-3.7, which indicate it would be cheaper to operate jets at 50 percent capacity than F-27 at 80 percent capacity. Using these parameters and the route passenger forecasts, jets would be needed on each route as shown in Table B-3.9.

Table B-3.6

SYRIAN ARAB AIRLINES - OPERATIONAL AIRCRAFT FLEET

Year	DC-3	DC-4	DC-6B	Caravelle	B707-320C	B707-420	B-727-200	B-747-SP	Total
1967	2	2	2	2					8
1968	1	2	2	2					7
1969	1	2	2	2					7
1970		2	2	2					6
1971		2	2	2					6
1972		2	2	3					7
1973			2	4					6
1974			2	4		2			8
1975				4	2	1			7
1976				4		1	3	2	10
1977				4			3	2	9
1978				4			3	2	9
1979				4			3	2	9

Table B-3.7

AIRCRAFT COST COMPARISON

	B 737 (SP)	F-27 (SP)
Captial Cost (Estimate)	58 million	23 million
Number of Seats	100	50
Total Cost per Seat-Kilometer	14.86 piasters	27.78 piasters
Total Cost per Passenger-Kilometer		
20 Passengers	74.30 piasters	69.46 piasters
50 Passengers	29.72 piasters	27.78 piasters
100 Passengers	14.86 piasters	27.78 piasters

Table B-3.8

SEAT-KILOMETERS PROVIDED BY 100 SEAT AND 50 SEAT AIRCRAFT ON 8 ROUTE DOMESTIC NETWORK

Daily Route-Kolometers - One Way

[DAM-ALP, DAM-LTK,
DAM-PLR, DAM-DEZ,
DAM-KAC, ALP-LTK,
ALP-DEZ, ALP-KAC] 2650 Kms

Seat-Kilometers

50 Seat Aircraft

1 Round Trip on each Route (2650 x 2 x 50) 265,000 Seat-Kms

2 Round Trips on each Route 530,000 Seat-Kms

100 Seat Aircraft

1 Round Trip on each Route (2650 x 2 x 100) 530,000 Seat-Kms

Table B-3.9

APPROXIMATE DATE OF JET PHASE-IN

Route	Year
DAM-ALP	1990
DAM-LTK	2000
DAM-PLR	After 2000
DAM-DEZ	1991
DAM-KAC	After 2000
ALP-LTK	1995
ALP-DEZ	After 2000
ALP-KAC	After 2000

It should be noted, finally, that the smaller turboprop aircraft, while being slower, will not make a large difference in Syrian route stage lengths. A flight from Damascus to Aleppo, for example, would take about 45 minutes in a jet and one hour in the turboprop, a small and acceptable time penalty.

INTERNATIONAL

The B 747 SP appears to be particularly ill-suited to the present Syrianair route structure. The aircraft design has been optimized for very long haul service, i.e., 8,000 to 10,000 kilometers; however, the average B 747 stage length on the Syrianair route system is 2,136 kilometers. By contrast, the average stage length of all B 747s used in regular scheduled service in the United States is twice that distance and that of B 747 SPs is three times the Syrianair average. If increased productivity were the principal objective behind the procurement of a wide-bodied four-engine aircraft, other models are available which have 80 percent greater passenger capacity and which can be operated at 100 percent payload on any of Syrianair's routes. On such relatively short hops, the B 747 SP is uneconomic and is highly fuel inefficient.

One alternative which logically surfaces is to dispose of the B 747 SPs and use the proceeds to purchase wide-bodied trijets or twinjets whose optimum stage length more closely matches the Syrianair route structure. Another alternative would require a re-examination of the present route structure, particularly with respect to the inauguration of non-stop service to the United States and to India. A third alternative, having a lower level of risk, is to enter into an operating arrangement with another Middle East carrier in which the Syrianair B 747s would

be used for long-haul service in exchange for a shorter range aircraft type which would be operated on present Syrianair international routes. In such an arrangement, not less than 50 percent of the long-range service to the United States and India should be conducted from Damascus. Operational control should continue to be vested in Syrianair.

It should also be noted that the average daily utilization of the Syrianair B 747 SPs in 1978 was 5.22 hours. While this rate was up from 3.67 hours in 1977 and 2.07 hours in 1976, it still represents an unacceptably low utilization. By contrast, the average utilization of B 747 aircraft in the United States air carrier fleet during 1977 and 1978 was 11.5 hours per day. Clearly, a substantially larger long-haul market must be found in order to achieve economical utilization rates for aircraft which involve an investment on the order of SP 500 million.

An effort to establish a joint arrangement with Royal Jordanian Airlines for service to the United States was initiated during 1978; however, expansion beyond the Syrian market to include additional Middle East transportation requirements should be given renewed consideration.

In contrast to the B 747 situation, Syrianair's B 727 fleet enjoys both a respectable 7.3 hours daily utilization and a very economical 1,445 kilometers average length. Average daily utilization decreases of necessity with decreased average stage length. These operating parameters compare favorably with most of the more efficient operators of these aircraft throughout the world. Furthermore, the average passenger occupancy which these aircraft generate is considerably above generally recognized break-even load factors throughout the industry. On its face, the operating statistics of Syrianair suggest a highly efficient use of the B 727 fleet. However, since the 1978 utilization rate of 7.3 hours per day is a decline from 8.4 hours daily utilization in 1977, caution is urged lest a continued diversion of traffic from the B 727s to the B 747s erodes this high level of operating efficiency. The questionable economics of B 747 utilization should not be remedied at the expense of the B 727, particularly since none of the B 727 routes are optimal for B 747 use.

The average utilization of Caravelle aircraft in Syrianair peaked in 1972 at 7.57 hours per day, a very acceptable performance for relatively short-haul aircraft. However, with the acquisition of the third and fourth aircraft in the Caravelle fleet, the daily utilization rate began to slip. With the addition of three B 727 aircraft in 1976, a further reduction in utilization occurred as Caravelles were displaced from the more lucrative and longer stage length West European routes and

increasingly used on less attractive international routes and in the very short haul, heavily subsidized, domestic service. In 1978 Caravelle daily utilization rates had declined to 4.96 hours, which must be regarded as a marginal, if not uneconomic, rate. However, so long as Syrianair is prevented from seeking fully compensatory domestic fares, little incentive can be expected to increase scheduled frequency and thereby increase Caravelle utilization.

Table B-3.10 gives average stage lengths for the various aircraft operated by Syrianair on its routes, compared to average stage lengths of aircraft operated in the U.S.

Table B-3.11 gives aircraft utilization data for all aircraft of Syrianair and average utilization of the same on comparable types of equipment for the U.S. air carrier fleet.

From this analysis, the conclusion is inescapable that the international route structure of Syrianair and the aircraft mix serving it are mismatched. Either the route structure must be altered or the aircraft employed must be changed to permit Syrianair to operate an economical and efficient service.

Development Plans

On the northeast side of its hangar at Damascus International Airport, Syrianair plans to build a completely separate engine shop building the design of which has been developed by Pratt and Whitney, the manufacturer of all the engines used by Syrianair. This facility will enable the carrier to accomplish engine build-up for each of the three types and will provide self sufficiency for all propulsion systems other than component overhaul. Three spare engines are owned for each aircraft type; this enables the carrier to schedule one in overhaul, one in inspection and build-up, and one in storage in installation readiness at all times.

A second major project under consideration by the company is a nitrogen storage facility, which will probably be incorporated within or adjoining the engine shop structure. The increasing use of nitrogen in modern aircraft has created an urgency in providing space for storage in a safe and efficient manner.

Maintenance of the Fleet and Equipment

Caravelle

Syrianair performs all light to medium airframe maintenance service and checks on Caravelle aircraft including the "Y" checks (annual) which are required at either 12-18 month intervals or at each 3,500 hours, whichever occurs first. The

Caravelle has been operated by the airline for 15 years and a sufficient number of skilled mechanics with adequate experience are in the employ of the company. However, major checks and overhauls, which are conducted at 54-60 month intervals or at 10,500 hours, whichever occurs first, are still contracted to other airlines or aircraft service companies abroad. Until recently, the major airframe inspections and overhauls have been accomplished at Aeronovale. Currently, arrangements are in effect to have future major airframe work done by Finnair despite the fact that the cost is greater and entails a longer ferry to Helsinki.

Although the company would like to reduce its dependence upon foreign aircraft services, it is doubtful that staffing and equipment for an average of less than one such maintenance operation each year would be justified. Unless a substantially larger fleet of aircraft were involved, Syrianair could not support such an elaborate maintenance overhead. Another alternative would entail the centralization of airline maintenance services in the Middle East so as to achieve economies of scale. While such a concept has real potential for some aircraft types, it would not apply to the Caravelle because of the age of the design. There simply are not enough of the aircraft still operating in the Middle East. Furthermore, the Company is actively considering a Caravelle replacement. The residual operating service in Syrianair would clearly be insufficient to amortize the cost of tooling and training even if other Caravelle operators could be induced to use Syrianair maintenance services in the short term.

The decision to replace the Caravelle will be based on operating economics rather than time limits on equipment airworthiness. The critical life of the Super Caravelle is currently estimated by the manufacturer at 45,000 take-off-landing cycles. On this basis, the present Caravelle fleet could be used at the current Syrianair utilization rate for at least 15 years more. However, far more efficient airplanes are available for both the longer stage length international routes and the short stage length domestic routes. Moreover, with each year the airplane can be expected to incur higher repair and maintenance costs. For instance, at the aircrafts' present age and as a result of their long exposure to high temperatures, their integral wing tank sealant has deteriorated and an expensive resealing is being accomplished during major airframe overhauls.

A similar pattern is followed for inspection and overhaul of the JT-8-7 engines which power the Caravelles. Syrianair personnel handle the hot section inspections at 3,500 and 7,000 hours. Engine build-up, installation, and removal is also

Table B-3.10

AVERAGE STAGE LENGTHS - SYRIAN ARAB AIRLINES

(First four months 1979)

Caravelle	
Domestic Service	430.4 Kms
International Service	1,095.0 Kms
Average	843.8 Kms
B727	
Arabic Service	1,529.4 Kms
European Service	1,522.4 Kms
Orient Service	1,170.3 Kms
Average	1,444.9 Kms
B747	
European Service	2,157.0 Kms
Orient Service	2,112.5 Kms
Average	2,135.5 Kms

Source: Consultants' estimates.

AVERAGE AIRCRAFT STAGE LENGTHS

TOTAL UNITED STATES AIR CARRIER FLEET

1977-1978

(Kilometers)

747	-	3,983.1
DC-10	-	2,243.4
1011	-	1,747.7
A-300B	-	1,245.6
727-200	-	821.7
727-100	-	906.2
DC-9-30	-	471.4
DC-9-10	-	449.8

Source: F A A.

Table B-3.11

AVERAGE AIRCRAFT UTILIZATION - SYRIANAIR FLEET

(hours per day)

Year	DC-6B	Caravelle	B727	B747
1970	3.57	8.72		
1971	5.35	10.65		
1972	1.63	10.09		
1973	1.67	6.92		
1974	.30	5.33		
1975		6.63		
1976		6.11	7.05	2.07
1977		5.08	8.40	3.67
1978		4.96	7.30	5.22
1979[1]		3.59	6.97	5.40

AVERAGE AIRCRAFT UTILIZATION

TOTAL UNITED STATES AIR CARRIER FLEET

1977-1978

(hours per day)

B747	-	11.5
DC-10	-	10.9
L1011	-	8.1
A300B	-	7.0
B727-200	-	8.0
B727-100	-	7.0
DC-9-30	-	7.4
DC-9-10	-	7.5

Source: FAA.

Based on first six months.

accomplished by the carrier. However, engine overhaul at 10,500 hours (or sooner if necessary) is contracted out to Sabena. The engines are flown to Munich in the B 747 schedules and trucked to Brussels. It does not appear that the limited size of the Caravelle fleet or the probable future use of the aircraft would warrant the development of significantly greater capability within Syrianair, and engine overhauls will probably continue to be accomplished abroad.

The consistent pattern of declining utilization of the Caravelle since 1971 appears to be unrelated to any maintenance or airworthiness problems. Parts procurement, service life minimums, and equipment reliability have been normal. Rather, the aircraft has been displaced from the longer stage international routes by the B 727 and, indirectly, by the B 747. Since it is used exclusively on the domestic routes, the average stage length has declined, with a consequent negative effect on utilization. Of greater importance still is the obsolete nature of the aircraft and the increasing difficulty it is having in competing with newer, particularly wide-bodied, aircraft.

Disposal of the Caravelles should be planned for the near future. Replacement capacity for short-haul international services should be negotiated with other Middle East carriers in exchange for unused B 747 SP capacity in very long haul, high-density markets. Replacement capacity for domestic service should be sought in more economical, high fuel efficiency, smaller turbo-propeller aircraft.

Boeing 727-200

When the B 727 (three aircraft) and B 747 (two aircraft) fleet was acquired in 1976, contractual arrangements were made with the manufacturer for the supervision of maintenance and the training of Syrianair mechanics. After one year of Boeing service, the carrier sought more economical arrangements that would prove more adaptable to scheduled airline operation. Accordingly, a contract was negotiated with Lufthansa for similar services in 1977. Since that time, Syrianair has been able to qualify a sufficient number of its own staff to take over all maintenance and inspection of the B 727 except for major airframe inspection and overhaul. After preliminary training at Boeing, Lufthansa provided training to qualify Syrianair mechanics for aircraft type ratings during 1977 and 1978. However, since early 1979, training for type ratings has been provided by TAP Airlines of Portugal.

The total time logged on the three Syrianair B 727 aircraft varies from 8,500 hours for the high time aircraft to 7,900

hours on the low time aircraft. The initial airframe overhaul time of 12,000 hours is still in effect for Syrianair. This will not be reached until some time in early 1981. However, it will rapidly follow thereafter for the remaining B 727s. Accordingly, a substantial reduction in available B 727 capacity can be anticipated during that year. Some adjustment in aircraft scheduling and some decision concerning aircraft replacement should be made well in advance. Since the B 727 enjoys an excellent route structure match, is experiencing good utilization, and is showing satisfactory load factors and revenues per passenger mile, major fleet adjustments will be required on the long haul and short haul ends of the spectrum rather than in the intermediate stage lengths. The B 727 should continue to serve as the backbone of the Syrianair fleet.

Syrianair will run at least two of the aircraft through airframe overhaul at 12,000 hours. During those operations, the carrier will seek to develop documentation concerning the condition of the aircraft to justify an extension of the time between overhaul (TBO) to 16,000 hours. Such an extension has already been sanctioned by the manufacturer, approved by the appropriate certificating authorities abroad, and adopted by many B 727 operators.

The JT-8-17 engine of the B 727 is scheduled for regular inspection at 4,000 hours; the engine TBO is currently approved at 8,000 hours. All major inspections and overhauls are being accomplished by Sabena. However, plans have been approved for the enlargement of Syrianair's maintenance plant which will enable the company to take over all inspection functions within the next three years. Engine overhaul will continue to be contracted outside Syria for the foreseeable future.

Boeing 747 SP

As with the B 727, Syrianair used Boeing to provide the preliminary training for B 747 mechanics in 1976 and Lufthansa took over the aircraft rating training in 1977. The Lufthansa service was considered by Syrianair to be excellent in quality but excessive in cost. Therefore, negotiations were begun in 1978 with Pan American World Airways for a B 747 training program geared especially to the SP model, which is a long-range version of the B 747. Of all the B 747 SPs delivered to date, Pan Am operates approximately 60 percent and is eminently qualified to render the service sought. For Syrianair there was the added incentive of having the training program funded in major part by the Agency for International Development (AID). Because of the long time required to negotiate approval of the program with the Ministry of Transport and AID, it was necessary to extend the Lufthansa contract. The Lufthansa service is

regarded by Syrianair to be so costly that some alternative, presumably Pan Am, will be sought in the near future with or without assistance from AID.

Assuming continued progress in qualifying Syrianair personnel, the company plans to handle all levels of inspection and maintenance below the major airframe overhaul, which is currently scheduled at 16,000 hours or seven years, whichever occurs first. At the present utilization rate, Syrianair will not reach the mandatory overhaul time until 1982. The five Lufthansa employees currently supervising B 747 maintenance and "signing off" aircraft airworthiness, or their replacements, will be retained until the training program is consummated.

As with the B 727, when the proposed engine shop is completed before the end of 1982, Syrianair will handle all engine inspection and installation short of the hot section inspection and component overhaul.

Support Equipment and Incidental Maintenance

Although the quality of maintenance of aircraft from the viewpoint of safety appears to be adequately controlled and continuing improvement appears to be assured, the same cannot be said for other areas of maintenance. Inspection of Syrianair aircraft and comments of passengers indicate a greater than normal evidence of neglect of incidental details. Seats often bear signs of frayed material and open seams in the upholstery. Accumulations of dirt in remote areas under seats gives an impression of careless cleaning procedures. Passenger seats usually are not equipped with seat-back covers although each seat is equipped with self-adhering strips designed to hold the covers in place. Reading lights and seat-back reclining controls are frequently inoperative.

An even greater impression of inadequate service and maintenance is conveyed in the Damascus terminal, where cleaning service is woefully neglected. While the service and maintenance of terminal facilities to a large extent are the responsibility of the airport management, it is nevertheless a matter of vital concern to all carriers using the airport. It is of particular concern to Syrianair, which has the largest stake in the commercial success of the airport and which has exclusive jurisdiction for the provision of ground services on behalf of all carriers.

Syrianair's ground services, which are universally in disrepute among foreign air carrier representatives, to a large extent

involve the unserviceability of ground support equipment. Mobile air conditioning equipment, power units, baggage and cargo loaders, and vacuum cleaners are frequently inoperative. Many complaints have been received indicating that unserviceability of equipment reached chronic proportions and had its most severe impact on travellers during the height of the summer travel season in 1979. An even worse indictment was that numerous offers by foreign air carriers to assist in the procurement of parts and servicing of ground support equipment have been declined by Syrianair.

There appears to be little, if any, organized training of ramp personnel and, in particular, of employees responsible for the operability of ground support equipment. The problem is exacerbated by the consistent abuse to which the equipment appears to be subjected by untrained ground service operating personnel. The general perception is that, even when skills are developed in this haphazard on-the-job training environment, it is difficult to retain the superior workers at the low wage levels which are paid. The lack of incentive which the system of recruitment, training, and compensation produces is not limited to service workers. The entire system appears to be biased toward inefficiency from the highest levels of management. There is no alternative available to users so far as ground service operations are concerned. There are no expert supervisors, as there are in airworthiness maintenance. There is no certification or other job qualification process which insures at least minimum training exposure. And there is a widespread concensus that managerial positions in areas such as ground services are not necessarily filled with principal regard for professional expertise, experience, and motivation.

Clearly, high priority needs to be accorded the selection, training, discipline, and retention of ground service employees generally and maintenance personnel in particular. A mechanism for regular consultation with all air carriers should be established at Damascus International Airport. An Airport Operators Committee (AOC) or its equivalent would permit service and maintenance deficiencies to be identified and solutions to be propounded in an effective manner. Early consideration should be given the need for alternative administrative arrangements for ground service and maintenance, and specific suggestions should be sought from the AOC.

Evaluation of Aircraft Equipment Recommendations

This section provides a partial analysis of the effect on Syrianair domestic and international aircraft operating costs, operating efficiencies, and investment requirements of convert-

ting the domestic aircraft fleet from the present Super Caravelle 10-Bs to F-27-600s and of converting the present B 747-SPs and Super Caravelle 10-Bs used in the international fleet to B 727 200s. The analysis requires a number of assumptions, enumerated here:

- no change in the present and planned route pattern,

- constant prices,

- traffic as projected in the Phase I Report of the Comprehensive Transport Study,

- implementation of recommendations in the Phase I Report concerning the air navigation system, airports, and domestic airways, and

- new and used international prices for aircraft as of May 1980.

A final and definite comparative analysis cannot be carried out because (a) Syrianair must prepare a complete route and scheduling plan for the proposed new fleet and (b) Syrianair aircraft operating cost data are more than two years in arrears and do not reflect the large increases in fuel and oil costs that have taken place recently. Nonetheless, this partial analysis clearly supports the recommendation for a turnover in Syria's fleet of B 747 SPs and Super Caravelle 10-B aircraft.

Major Aircraft Operating Expenses

Domestic Fleet

Except for one leg (Damascus-Aleppo) flown by a B 727 aircraft en route to Germany and referred to earlier, all domestic flights are carried out by Super Caravelle 10-Bs. The four Caravelles in the Syrian fleet devote about 20 percent of their revenue flying hours to domestic services. As pointed out earlier, only two domestic airports out of five are now being served and frequencies are low. However, the average load factor on the domestic Caravelle flights is very high.

Major aircraft operating costs are:

- crew,
- fuel and oil,
- flight equipment maintenance, and
- depreciation of equipment.

Table B-3.12 compares these costs for a DC-9-10 and an F-27-600. The DC-9 costs were used as a surrogate for Caravelle costs since the Civil Aeronautics Board does not report aircraft operating expenses for the Super Caravelle aircraft. In any event, the Caravelle fleet is obsolete.

It is likely that both fuel and oil costs and maintenance are considerably higher for the older Caravelles owned by Syrianair than for the DC-9-10.

Assuming total annual operating hours of 3,500 on domestic routes for Caravelles (DC-9-10) and 4,500 hours with a fleet of F-27s operating considerably more frequent schedules, annual major costs for the two planes would be:

Super Caravelle (DC-9-10)	$2.6 million
F-27	$2.2 million

Higher utilization of the F-27 fleet reflects its slower speed and greater frequencies of service to domestic airports. The F-27 would be offering annually over 5,000 more seat hours plus two to three times more flight frequencies than those offered by the Caravelle type of aircraft. The F-27 would also show higher equipment utilization than the 3.59 hours per day logged by the Caravelle in 1978, perhaps almost double.

International Fleet

The present Syrianair fleet of aircraft employed on its international routes consists of two very long range B 747 SPs, three B 727 200's, and four Super Caravelle 10-Bs (20 percent of flying hours are on domestic routes). It is proposed that the B 747 SPs and the Super Caravelles be replaced with two additional B 727 200s. The reasons for these equipment recommendations are set forth earlier in this chapter.

Major aircraft operating costs for the B 747 SP and the B 727 200 are given in Table B-3.13. The operating costs for the Super Caravelle, also used by Syrianair for its shorter international routes, are presented in Table B-3.14.

Applying aircraft utilization reported by Syrianair in 1978 and given in Table B-3.11, and assuming a daily utilization of 340 days per year, 1978 total operating costs for the present fleet serving international routes are given in Table B-3.14.

If Syrianair were to dispose of its fleet of B 747 SPs and Caravelles and acquire two additional B 727 200s to serve its international routes, savings in annual aircraft operating

Table B-3.12

MAJOR AIRCRAFT OPERATING EXPENSES

(per block hour in US dollars, 1978)

(Average for all US scheduled airlines)

Cost	DC 9-10[1]	F-27
Crew	218.62	186.31
Fuel and Oil	341.76	109.49
Maintenance		
- Airframe	60.79	127.48
- Engine	65.33	69.80
Depreciation		
- Airframe	41.26	4.28
- Engine	15.36	1.20
Total	743.12	498.56

Source: US Civil Aeronautics Board, Aircraft Operating Cost and Performance Report, July and November 1979.

[1] Surrogate for Super Caravelle.

Table B-3.13

MAJOR AIRCRAFT OPERATING EXPENSES

(per block hour in US dollars, 1978)

(Average for all US scheduled airlines)

Cost	B-747-SP	B-727-200
Crew	751.37	323.58
Fuel and Oil	1285.03	573.26
Maintenance		
- Airframe	54.81	64.75
- Engine	31.56	37.59
Depreciation		
- Airframe	56.61	94.90
- Engine	27.98	22.10
Total	2207.36	1116.98

Table B-3.14

ANNUAL AVERAGE MAJOR OPERATING COSTS

(US dollars)

Aircraft	Hours per Day Utilized	Annual Hours Utilized	Cost/hr.	No. of Aircraft	Annual Operating Costs (US$ million)
B-747-SP	5.40	1836	2207.36	2	8.1
B-727-200	6.97	2370	1116.98	3	7.7
Caravelle	3.59	1221	743.12	3	2.7
					18.5

costs would be $5.6 million. Other savings not costed would derive from maintaining only one type of aircraft instead of three. Training costs would also be considerably reduced.

It must be remembered that the comparative aircraft cost analyses used in this section are based on costs reported by the US scheduled air carriers. These costs by aircraft type are not obtainable from Syrianair. Thus, our analysis does not reflect the real Syrianair aircraft operating cost picture. However, since the study is a comparative analysis among aircraft types, the differences are not likely to be significant even though the overall magnitudes of the costs could be different under Syrian conditions.

Cost and Prices of Aircraft Equipment

Prices of new and used aircraft can vary significantly in the international market, depending on timing and circumstances. However, the market is well organized with a number of well-informed aircraft brokers operating internationally. The prices for new aircraft as well as used aircraft given here have been obtained from the manufacturers and from the aircraft brokers that deal in both new and used aircraft. They reflect going prices as of May 1980.

Under the recommendations of the Consultants, Syrianair would dispose of its two B 747 SPs and its three Super Caravelle 10-Bs. After considering the ages of the two types of aircraft, aircraft brokers felt that the following price ranges were reasonable:

B 747 SP	$47 million to $52 million
Super Caravelle	$600,000 to $700,000

Thus, Syrianair might realize from $94 million to $104 million on the sale of the two B 747 SPs, and $1.8 million to $2.1 million for its three Caravelles.

Our recommendations are that the B 747 SPs be replaced with two B 727 200s, each costing new $14 million for the aircraft alone; that three F-27s be purchased for the domestic service at a cost of $5 million new, and that two new aircraft be purchased to meet the projected increase in international passenger demand and to replace the Caravelle in international service. We have used an airbus/B 767 type aircraft for costing the investment in additional aircraft, but the exact aircraft to be selected would need to be based on a detailed feasibility study.

One alternative the Government may wish to consider would be to buy the additional aircraft for the international service at

the beginning of the 5th Plan and devote the Caravelles exclusively to the domestic service for the next several years. While the Caravelles are not efficient for this purpose, it would enable the Government to gain a better knowledge of domestic demand under conditions of regular service before making a decision on new domestic aircraft.

For the period 1986-2000, six additional aircraft will be needed for the international service, and two B 737 type aircraft will be required as domestic demand expands.

These investments are reflected in the financial analyses in Chapter B-5 below.

Used B 727 200s are available in the international market. Prices vary widely with age, condition, and configuration. International aircraft brokers quoted prices as low as $2 million and as high as $5 million. The Consultants were unable to get a price quote for a used F-27.

The Consultants also looked into the possibility of leasing these aircraft but found no aircraft broker prepared to give quotations because of the myriad different conditions and approaches in the aircraft leasing business. However, such leases can be negotiated in specific instances.[1]

Seat/Kilometer Costs by Aircraft Type

Again using 1978 data reported to the Civil Aeronautics Board by US scheduled carriers, the Consultants calculated costs per seat-kilometer for the types of aircraft under discussion. Per kilometer costs are obtained by first dividing total aircraft operating costs by the block speed per kilometer. This gives aircraft operating costs per kilometer. Costs per kilometer are then divided by the average available seats per kilometer to obtain seat-kilometer costs. Table B-3.15 gives the results.

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[1] International aircraft prices used in this section were obtained through the courtesy of US Aircraft Sales, Inc., McLean, Virginia.

Table B-3.15

SEAT/KILOMETER COSTS

Aircraft Type	Seat-Km Costs (in US cents)
DC-9-10	5.41
B 747 SP	3.20
B 727 100	5.07
F-27	14.78

The B 727 100 aircraft costs per seat-kilometer are less than those of the DC-9-10 used in lieu of cost data for the Super Caravelle. But, because of their very high fuel consumption and the fact that these aircraft are obsolete, seat-kilometer costs for the Super Caravelle are bound to be considerably higher than those of the DC-9-10. The B 747 SP seat/kilometer costs are very low. This reflects not only the large number of seats in the aircraft but also the very long staging used by US carriers. Syrianair stage lengths for its B 747 SPs are less than half the average flown by US carriers, and this use of the plane raises seat-kilometer costs. The high F-27 seat-kilometer costs reflect not only the small number of seats available but also the slower speeds of turboprop aircraft as opposed to all jet aircraft.

It is important to emphasize that Syria's domestic air network should not be allowed to fall into the trap that so many airlines around the world have experienced. This is to opt for ever larger equipment as traffic grows. The result is fewer and fewer frequencies with a corresponding loss of overall traffic as well as convenience to the air traveller. The only way that the pent-up demand for domestic air travel in Syria will be filled is by operating a smaller aircraft with considerably higher frequencies of service than those now operated with the Super Caravelle.

Seat-kilometer operating costs cannot be used by themselves in any comparative analysis of aircraft types. They will, however, be useful in determining fares and assessing overall aircraft performance. Once routes, frequencies, and anticipated load factors are determined for a new fleet, overall costs and profit can also be determined by applying this unit of cost performance.

CHAPTER B-4

TRAFFIC PROJECTIONS

Chapter B-4

TRAFFIC PROJECTIONS

DOMESTIC AIR TRAFFIC PROJECTIONS

There are many reasons why the historic record for domestic air traffic does not reflect the potential demand for air service. Nor do available statistics for airports other than Damascus permit the development of air travel trends over the past ten years. Thus, projections cannot be based upon extrapolation of past trends, nor does actual air traffic by city pair in 1979 provide a base from which projections can be made.

The reasons why domestic air traffic statistics do not accurately reflect air traffic demand include:

- unreliable service, leading to a large percentage of flight cancellations,
- overbooking because of insufficient capacity,
- low frequency of scheduled flights,
- arbitrary and lengthy closing of airports for runway repairs and other reasons,
- absence of navigation and landing aids, and
- inadequate promotion and little sales effort.

Because actual Syrianair traffic in 1979 does not adequately reflect the demand for air services, a different approach has been used to determine potential air traffic demand.

First, an appraisal of the value of air service related to time savings, income levels, and trip purpose was undertaken. This was used to support the basic assumption that substantial potential demand exists for domestic air services in Syria. Subsequently, a detailed air passenger forecast by city pairs was developed using city-pair passenger forecasts of total traffic and certain assumptions about the percentage of total traffic that could be diverted to air over time if a regular and reliable air service is developed.

Value of Air Service

Assessment of the value to the consumer of the time savings which domestic air transportation offers is a difficult but

necessary task. Unfortunately, the process requires a greater supply of information concerning travellers generally and the purpose of their trip than is currently available. Historically, it has been found that the more nearly a trip involves business-related functions, the closer the value of travel time approximates the traveller's hourly income. On the other hand, the value assigned to time by an individual is also directly related to the urgency which he or she attaches to the particular trip. "Urgency" is a highly subjective ingredient which defies precise quantification. Nevertheless, quantitative judgments have been applied frequently in making such assessments and have been useful in forming approximations of demand levels. One such generalization has assumed a value of time equal to total hourly personnel cost for all business travel and 33 percent of this level for all social or tourist travel of wage earners and their dependents.

Table B-4.1 shows the comparable time and costs differences on three important air lines in Syria. These time savings are just on the trip itself. If, for example, convenient twice-daily service (morning and evening) were provided to main centers, additional large time savings would be possible by allowing same-day return trips for businessmen.

Table B-4.2 shows the distribution of Government employees by hourly usage rates. Based on this table, current transportation rates, and estimated savings in time in travelling by air on a trip to Aleppo, virtually all Government business travel would be by air. However, if personal-travel time savings are only valued at one-third of the business time, only a small proportion of personal travel, probably less than 2 percent, would be by air.

Salary levels in the private sector are at least as high or higher than the Government levels. While overall wage levels for the private sector are not available in published statistics, the Consultants' own research in the largely private highways-transport industry indicated that truck and bus drivers' salaries ranged from a low of SP 5.22 per hour for a 2-axle truck up to SP 11.24 per hour for a semitrailer truck. Thus, the more skilled workers on larger vehicles and buses are within the same range as the upper 20 percent of the Government workers. In fact, this comparison would be even more meaningful if the private sector hourly earnings were adjusted to reflect the greater number of hours worked in the private sector, i.e., eight hour days versus six hour days in the public sector. On this basis, the private sector total wages per month would be well above public sector levels. This comparison serves to demonstrate that in the public sector as well, a large proportion of business travel and a larger proportion of private travel (because of higher overall incomes) would be by air.

Table B-4.1

COST/TIME RATIOS-AIR VS. SURFACE TRANSPORT OPTIONS

	Cost SP	Travel Time	Terminal Time	Total Time
		hr:min	hr:min	hr:min
DAM-ALP				
Air	40.00	0:45	1:15	2:00
Bus	15.50	5:45	0:45	6:30
Cost Difference	24.50			
Saving by Air				
Time				4:30
Value	5.44			
DAM-KAC				
Air	100.00	2:10	1:15	3:25
Bus	43.70	15:45	0:45	16:30
Cost Difference	56.30			
Saving by Air				
Time				13:05
Value	4.30			
DAM-DEZ				
Air	60.00	0:50	1:15	2:05
Bus	31.10	11:30	0:45	12:15
Cost Difference	28.90			
Saving by Air				
Time				10:10
Value	2.84			

Table B-4.2

DISTRIBUTION OF GOVERNMENT EMPLOYEES BY APPROXIMATE HOURLY WAGE RATES

Average Wage Rate/Hr[1] SP	Number in Category[2]	Percent
4.75	10,542	3.3
4.75-6.25	81,875	25.8
6.26-7.25	100,104	31.6
7.76-9.00	62,818	19.8
9.01-10.25	33,893	10.7
10.26-11.75	15,734	5.0
11.76-12.50	8,975	2.8
12.50 +	3,332	1.1
	317,277	100.0

[1] Calculated by using 1/7/77 rate plus 1/2/78 and 1/2/80 increases.

[2] Numbers for 1/2/78.

Source: Statistical Abstract Syrian Arab Republic August, 1978.

The O & D surveys undertaken in the present study indicated a high proportion of work-oriented trips in the passenger mix between city pairs.

Even if business-oriented trips are considerably below that indicated in the O & D surveys, high potential volume is indicated.

It should be recognized in the analysis that the time/cost savings per hour in Table B-4.1 are based on relatively low air fares. The SP 40 one-way fare to Aleppo is about SP 123 per passenger-kilometer, whereas a fare to the airline that would pay all its costs would likely be double this amount. This would double the value of air travel related to wage levels to nearly SP 11 per hour. Referring again to Table B-4.2, this would restrict Government business travel to about 6 percent of the total employees and a much higher proportion of private business travellers, probably about 25 percent of the total. Thus, of all business-related trips, perhaps 15 percent would be by air. Using these data, a rough approximation of potential air traffic on the Aleppo-Damascus route was calculated, based on 1979 O & D data, and is shown in the following:

One-Way Trips DAM-ALP	Work Related Trips at 60% of Total	Potential Air Trips at 25% of Work and 2% of Remainder	Scheduled Capacity-1979 (seats)
1,100,000	670,000	100,000	16,900

Further refinement of a "value of time" measure is hardly justified since even the crudest approximation leads to the conclusion that the potential air market exceeds by a factor of as much as seven the current capacity and schedule constraints. At the present time, passengers who travel by air between Damascus and Aleppo represent less than 1 percent of the total passenger movements between these cities, whereas the income data indicate a potential of 50,000 one-way trips.

Air travel between Damascus and the more distant Deir Ez Zor, where the difference in travel time is 10-12 hours one way, accounts for over 30 percent of the total movements between these cities (Table B-3.4). If, as the foregoing demand estimate assumes, "wait" time can be reduced to an insignificant amount through a marked increase in schedule frequency, air travel could be expected to increase to a much higher level.

It has been noted that in the short-haul air markets where travel time differentials are relatively small, the passenger mix tends to skew toward business travel. However, it is also true that the availability of frequent short-haul air transpor-

tation, with its high percentage of business travel, tends to strengthen commercial ties in city-pair markets to a greater extent than does personal travel in which surface mode options are more frequently utilized.

This analysis indicates that even with conservative assumptions with respect to air fares and percent of work trips, a substantial potential for air travel between Damascus and Aleppo (and other city pairs) appears to exist. Further traffic surveys particularly with respect to trip purpose for both air and surface traveller is required in order to establish potential traffic more precisely. The recommended airport master plans should include the development of such data for each of the airports. It would also be useful if Syrianair could undertake an O&D survey on domestic routes as part of the plans for domestic fleet expansion.

Air Traffic Diversion

The previous analysis indicates that the potential market for air services exists in Syria, but it is not a firm basis for developing city to city forecasts. However, using this as general support for an air passenger forecast, coupled with current air traffic and a total passenger forecast for all modes, a forecast by city pairs has been developed.

Drawing upon the experience of other developing countries with a relatively well-developed surface transport network and an improved air network, a conservative average estimate of passenger diversion from surface to air for 1979 might be about 1 percent. However, since air passenger traffic historically has increased more rapidly since the end of World War II than has surface passenger traffic and shows every sign of continuing to do so, it is logical to assume a higher average diversion of surface passenger traffic to air traffic, and a further increase in percentage diversion from surface traffic by 2000 has been assumed. Where current air traffic is less than 1 percent of total movements, it is assumed that improved air service will raise this to 1 percent by 1985 and to 1.5 percent by 2000. Where air is already above 1 percent of total traffic, the current level is assumed with a 50 percent increase by 2000. Thus, it is assumed that 45 percent of the trips between Damascus and Deir Ez Zor will be by air in 2000. Table B-4.3 shows the results of the analysis. The assumptions used are admittedly arbitrary, particularly with respect to traffic diversion. But the assumptions are almost certainly conservative when the income analysis of passengers is considered and the present traffic of Damascus-Deir Ez Zor and Damascus-Al Kamishli are considered. Both of these distant and difficult-to-reach locations have an already much higher share of traffic

by air. The forecasts in Table B-4.3 show a growth of domestic traffic to 170,000 passengers in 1985 and 668,000 in the year 2000.

This forecast produces a total passenger movement very similar to the total in the study undertaken by Boeing Commercial Airplane Company for Syrianair in 1978. That study applied various growth rates to 1977 traffic levels. The results differ on some route segments between the two studies, especially Damascus-Deir Ez Zor and Damascus-Lattakia, but this appears to be a function of the more recent data used in this study as well as the differing methodologies.

Passenger studies in the Sudan suggest that the suppression of demand due to poor service may be somewhat less than that inherent in the Consultants' forecast for 1985. However, the absence of service on some routes and the extremely sporadic nature of service on others in Syria appears to justify the Consultants' 1985 forecast. This is supported by the increases in traffic to Deir Ez Zor and Al Kamishli that regular service has recently produced. The forecast for 2000 is comparable to 1977 air traffic shares in the U.S. for similar distances, and this might be somewhat optimistic, assuming that the surface travel times in Syria are comparable by then. However, the Consultants consider that, given the unknowns, the forecast is adequate for long-range planning purposes. Syrianair will have nearly 10 years of actual experience with regular domestic service before any investment decisions beyond the purchase of a nucleus fleet need to be made.

INTERNATIONAL AIR TRAFFIC PROJECTION

As pointed out in Chapter A-3, the unsettled political condition in the Middle East during the decade of the 1970s had a marked impact on the flow of total passenger traffic at Damascus International Airport. International passenger volumes carried by Syrianair reflect the sharp fall-off in traffic in 1972-1973, the abnormal annual average growth because of the diversion from Lebanon that peaked in 1976, and a sharp drop in 1979 as air service was resumed in Lebanon. Over the nine-year period, the average annual rate of growth was very high, 21.5 percent. It cannot be expected to continue at such a high rate.

These distortions caused by events unrelated to air passenger traffic make the application of trend analysis to traffic forecasting risky at best. If the trend analysis is extended back through the years of abnormal growth, then the extrapolated annual average rate of growth would be too high (over 20 percent).

On the Middle East routes served by Syrianair, recent growth trends have averaged 20 percent annually or more. As indicated

Table B-4.3

PROJECTED DOMESTIC AIR TRAFFIC 1985-2000, THOUSANDS OF TRIPS

	1979			1985			2000		
	Surface	Air [1]	%	Surface	Air Diversion	Air	Surface	Air Diversion	Air
DAM - ALP	2,089	6.1	.3	2,625	1.5 [2]	40	7,064	2.0	141
DAM - LTK	1,429	-	-	1,879	1.0	19	4,457	1.5	67
DAM - PLR	45	-	-	45	-	-	102	NA	6*
DAM - DEZ	17	33.8	198.8	23	NA	46*	58	NA	175*
DAM - KAL	10	11.6	113.7	14	NA	15*	36	NA	53*
ALP - LTK	2,227	-	-	2,961	NA	24*	7,979	NA	123*
ALP - DEZ	1,091	-	-	1,517	1.0	15	4,049	1.5	61
ALP - KAL	741	4.2	.6	1,096	1.0	11	2,821	1.5	42
Total	7,645	55.8	.7	10,160	1.7 [3]	170	26,566	2.5 [3]	668

[1] Actual.

[2] Aleppo Airport closed much of 1979.

[3] Resulting factor from individual estimates.

* Estimates based on 1979 air traffic and special factors which make the relationship of air to surface traffic meaningless.

Source: Table B-3.5 and Consultants' traffic forecasts.

in Chapter A-3, overall air traffic trends at Damascus International Airport are in close accord with regional air traffic trends. However, the high annual growth rate for the region occurred during a period of rapid increase in foreign exchange earnings from high oil prices. These in turn have been invested in infrastructure projects and greatly increased imports of goods and services into the region. These have generated a large demand for air traffic. Much of this economic activity will continue through the remainder of the century, both in the oil-producing countries and in those receiving development funds from the oil countries.

If one assumes that political conditions, and hence stability, will improve somewhat throughout the remainder of the century, then it is reasonable to expect an average annual rate of growth of Syrianair international passenger traffic of 17 percent through 1985, declining thereafter to 10 percent through 1990 and perhaps 6 percent between 1991 and 2000.

Applying these growth rates, projected international passenger traffic for Syrianair is given below:

1979	1985	2000
395	1,013	2,921

As discussed in Chapter A-3, Boeing Commercial Airplane Company undertook a detailed Boeing route-by-route traffic analysis for Syrianair in 1978. The forecast for 1985 showed a total of 1.6 million international passengers, 60 percent higher than the above forecast. The reason for the difference appears to be that Syrianair has not recovered traffic as quickly after the 1977 drop as assumed by Boeing and that it has in fact been losing the market share. Boeing estimated market share for Syrianair at about 53 percent for Damascus arrivals and departures. In 1979, however, that share appeared to have dropped to about 38 percent. Hence, while the Boeing forecast for total traffic through Damascus is close to the actual experience in 1979, Syrianair has not shared proportionately in the growth. However, if Syrianair can recover its lost position and add some new routes, then the Boeing forecast would appear to be reasonable in 1985 at 1.6 million total international passengers. If, however, the apparent loss of the market share persists and assumed regional growth rates are achieved, then total passengers will be closer to the forecasts shown above.

Neither forecast deals sufficiently with the potential for increasing Syrianair's share of the international market through such alternatives as new routes and marketing strategies. This type of extended analysis would require a separate study. Before such a study is undertaken, the Consultants believe that attention should be concentrated on improved management and the inefficiency of the present fleet.

CHAPTER B-5

SYRIAN ARAB AIRLINES – FINANCE

Chapter B-5

SYRIAN ARAB AIRLINES - FINANCE

ACCOUNTING INFORMATION SYSTEM

Chapter B-5 of the Final Phase I Report presented a detailed analysis of the past financial performance of Syrianair. A major conclusion flowing from that analysis was the need for improvement in Syrianair's accounting information system.

The company is two to three years behind in issuing financial statements. The 1977 balance sheet and income statement had just been completed in early 1980. The statements suffer from improper accounting practices, such as double counting, poor definition of chart of accounts, and misleading aggregations for analytical purposes. This has been especially true since 1977, when the company was requested to shift to the Unified Government Accounting System. Thus, the company switched from its own financial accounting system, which needed improvement, to a system that is even less suited to the nature of operations of an airline. It should be stressed here that although the Unified Government Accounting System can be elaborated to suit the airline needs, this has not been done because of the inexperience and lack of formal accounting training of the airline's accounting department staff.

Furthermore, Syrianair does not have a cost accounting system. This implies that no cost centers are identified, no cost elements are specified, no cost standards are established, and no measurement and evaluation of actual costs in relation to standard costs are performed. The company does not have the system and procedures to measure the costs by route, although it does generate information about the revenues by route.

Whatever cost per route information the company did have consisted of estimates based on cost standards (i.e., fuel and maintenance per flying hour per type of aircraft) provided by the aircraft manufacturers. These standards would apply for ideal flying conditions (such as certain ranges of haul and so forth) but do not necessarily apply to the type of routes Syrianair flies. (During 1980 the company began to develop block hour costs based on its own experience.) If Syrianair cannot calculate actual costs per route, it can never ascertain the profitability of its present or proposed routes.

It is recommended that Syrianair hire an accounting consultant to develop and supervise the implementation of an integrated financial and cost accounting system.

FINANCIAL PROFITABILITY ANALYSIS

Table B-5.1 shows the Consultants' estimated financial profitability analysis for Syrianair, by plan period, from 1981 to 2000. These estimates are based on the Consultants' recommended aircraft investments and forecasts of passenger demand. Although it is not apparent from Table B-5.1, the profitability forecast by year for the 5th Plan period clearly reflects the effects of replacement of the B 747 SP aircraft and Caravelles and the Consultants' forecast substantial increase in passenger traffic. A projected net loss of SP 41 million in 1981 has turned into a substantial net profit by 1985.

The company shows a substantial net profit over the twenty-year period, with profits increasing in future years as more efficient aircraft and better aircraft utilization, due to increasing demand, take effect. Forecasts twenty years in the future are subject to a high degree of uncertainty, and the profits projected for the period 1996-2000 may be optimistic. However, the forecasts for 1981-1985 and 1986-1990 are certainly more reliable and are indicative of the company's potential if operations are nationalized.

Table B-5.2 shows the investment costs and funds available for Syrianair, by plan period, from 1981 to 2000. The table shows that Syrianair can finance its required investments in terms of both foreign exchange and total funds available for each of the four plan periods. However, for the 5th plan period, this outcome is dependent on the proposed sale of the B 747 SP aircraft. If these are not sold, Syrianair will require Government funds totalling SP 293 million in foreign exchange to make the aircraft purchases required to provide a viable domestic air service and to meet expanding international demand.

Table B-5.1

FINANCIAL PROFITABILITY ANALYSIS OF SYRIAN ARAB AIRLINES, 1981-2000

(million SP)

	1981-1985	1986-1990	1990-1995	1996-2000	Total
Revenues					
Passenger	2,247.7	4,093.7	5,904.4	7,803.3	20,049.1
Cargo	130.0	181.3	216.9	252.5	780.7
Baggage	87.6	124.8	134.9	144.9	492.2
Mail	7.0	7.5	8.0	8.5	31.0
Other	258.1	449.1	490.4	531.8	1,729.4
Total Revenues	2,730.4	4,856.4	6,754.6	8,741.0	23,082.4
Operating Expenses					
Crew Wages	84.8	118.5	153.7	176.8	533.8
Fuel	820.1	1,118.4	1,464.8	1,821.6	5,224.9
Maintenance	191.4	241.1	315.8	385.6	1,133.9
Landing and Over Flight	152.5	202.8	264.8	317.8	937.9
Handling	104.5	183.7	236.0	287.9	812.1
Insurance	29.2	43.0	56.0	67.3	195.5
Other	56.9	95.4	124.7	149.6	426.6
Total	1,439.4	2,002.9	2,615.8	3,206.7	9,264.8
Operating Profit before Depreciation	1,291.0	2,853.6	4,138.8	5,534.3	13,817.6
Depreciation	210.4	312.8	405.1	336.5	1,264.8
Operating Profit	1,080.6	2,540.8	3,733.7	5,197.8	12,552.9
Other Expenses	445.0	457.5	470.0	482.5	1,855.0
Profit Before Tax	635.6	2,083.3	3,263.7	4,715.3	10,697.9
Tax	419.1	1,374.6	2,153.6	3,111.7	7,059.0
Profit after Tax	216.5	708.7	1,110.1	1,603.6	3,638.9

Source: Consultants' estimates.

Table B-5.2

FINANCIAL PLAN - SYRIAN ARAB AIRLINES 1981-2000

(million SP)

	1981-1985			1986-1990			1991-1995			1996-2000			TOTAL		
	FO.EX	LO.CU	TOTAL	FO.EX	LO.CU	TOTAL	FO.EX	LO.CU	TOTAL	FO.EX	LO.CU	TOTAL	FO.EX	LO.CU	TOTAL
Capital Expenditures															
International Aircraft Replace 747	125.6		125.6										125.6		125.6
New	314.0		314.0	314.0		314.0	314.0		314.0	314.0		314.0	1,256.0		1,256.0
Domestic Aircraft	67.3		67.3	66.7		66.7				66.7		66.7	200.7		200.7
Total Capital Expenditures	506.9		506.9	380.7		380.7	314.0		314.0	380.7		380.7	1,582.3		1,582.3
Funds Available															
Internally Generated	166.5	260.4	426.9	429.0	592.5	1,021.5	742.4	772.8	1,515.2	873.0	1,067.1	1,940.1	2,210.9	2,692.8	4,903.7
Sell B-747 SP s	376.0		376.0										376.0		376.0
Sell Caravelles	7.0		7.0										7.0		7.0
Total Funds Available	549.5	260.4	809.9	429.0	592.5	1,021.5	742.4	772.8	1,515.2	873.0	1,067.1	1,940.1	2,593.9	2,692.8	5,286.7
Excess/Deficit	42.6	260.4	303.0	48.3	592.5	640.8	428.4	772.8	1,201.2	492.3	1,067.1	1,559.4	1,011.6	2,692.8	3,704.4
Cumulative Excess Deficit	42.6	260.4	303.0	90.9	852.9	943.8	519.3	1,625.7	2,145.0	1,011.6	2,692.8	3,704.4	-	-	-

Source: Consultants' estimates.

Notes: Internally generated funds are after tax.
FO.EX = Foreign exchange.
LO.CU = Local currency.

CHAPTER B-6

TRAINING

Chapter B-6

TRAINING

EXISTING SITUATION

Present training at Syrianair, although theoretically under the guidance and coordination of the manager of training in the Planning Department, is in fact fragmented and of varying quality and effectiveness. Some departments provide training in areas they believe critical, but this training may not even be known by the training manager.

The basic reasons for this situation are:

- Lack of a policy statement and organizational charter for the Training Section which outlines its responsibilities, functions, and authority.

- Lack of adequate facilities for training. Although a Syrianair Training Center was included in the budget for the 4th Five-Year Plan, it has yet to be built. With the various departments of Syrianair scattered in several locations, training in presently limited classroom space is difficult.

- Lack of an integrated long range (five year) training plan based on identified needs and priorities.

- Inadequate training budget. Although exact figures are unavailable, it is estimated that about 3 percent of Syrainair's 1980 budget was allocated to training; 10 percent would be a more realistic amount. However, until a training center is built, it would be difficult to use that amount effectively except for increased out-of-country training.

The 1980 training budget of SP 7 million was allocated as follows:

	Approximate Percent of Budget
Technical Department	50
Flight Operations	43
Ground Operations	3
Commercial Department	3
Financial Department	0.5
Planning Department (including Training Section)	0.5
	100

USAID has recently approved the foreign training of 80 ground aviation personnel in the following areas of study.

- air frame and engine,
- autopilot and electronic/electrical instruments, and
- radio and radar.

A total of 10 classes will be held for 8 students each in the above areas at the Pan American School in New York City. These courses will greatly strengthen the Technical Department's maintenance capability.

As described in more detail in Chapter A-2, the UNDP in coordination with the ICAO is in the last year of a two-year program that has the basic objective of improving the efficiency of the air transport sub-sector. A plan for a follow-on UNDP/ICAO project has yet to be approved.

Although this program was intended to cover basic needs of both the DGCA and Syrianair, much of the work relevant to Syrianair is not yet done, including:

- preparation of a maintenance organization and procedures manual,

- preparation of an inspection manual,

- management policy and planning of training for the airline,

- on-the-job training in production control maintenance schedules, inventory, and stock control,

- establishment of an airline training organization, and

- establishment of Syrianair's Technical Department as an approved maintenance organization.

One key task that was recently completed was an organization and management study by two aviation experts under UNDP/ICAO sponsorship (ICAO Interregional Project SYR/76/009 dated Feb. 1980).

Since the UNDP/ICAO future work will hopefully be more oriented toward the above-noted areas of Syrianair's needs, the Consultants will not elaborate on these areas except to emphasize their importance.

Many of the problems noted elsewhere in this report, particularly ground handling, are being addressed through training activities within a limited budget. Perhaps of more importance in the long run has been the appointment of a new Ground Operations Department director and a forthcoming reorganization of the department to strengthen the areas of poor performance noted. Additional ground equipment has been received and is in operation. It is unlikely that the chaotic condition in the existing terminal will be resolved, because of the terminal's inadequacy.

RECOMMENDATIONS FOR FUTURE ACTION

Immediate attention should be given to development of a Syrianair Training Center, ideally located near Damascus International Airport. Terms of reference for this center should call for the following:

- Conduct a manpower requirements analysis for Syrianair to identify existing and future skill shortages.

- Develop a long-range plan to fill projected skill shortages.

- Conduct an in-depth analysis of all operations to identify problem areas in each department; assign priorities and recommend appropriate training programs, including: qualifications of instructor staff; classroom space; training aids, including mock-ups and other special aids; and curriculum development needs.

- Recommend types of facilities needed for each identified type of training and estimate floor space required for classrooms, specialized instruction areas, and structured on-the-job training.

- Prepare preliminary architect and engineering specifications for the center and identify the most feasible location.

- Prepare a capital expenditure and an operating budget for construction and operation of the Training Center.

- Prepare job specifications for key personnel and a plan for outside recruitments of experts not available within Syria.

- Specify special training of instructors.

Any plan for training should involve the line department managers and their key staff. Present training in some departments

is done completely by these managers. They have the incentive to do this because they are paid extra for course preparation and for presentation if the courses are given during off hours. This practice is a good one and should be encouraged. The training effectiveness of such programs would increase with the establishment of a Training Center which could provide back-up support in curriculum development, training aids, and prior courses in training the trainer.

It is proposed in the next section that an outside expert work with Syrianair's training manager on the above items. In addition, the Training Section should add the following as a minimum to its staff:

- two instructors,
- one expert in curriculum development, and
- one graphic arts expert.

Adding these personnel would relieve the training manager of some of the day-to-day teaching and preparation load and allow for more time to plan an integrated training program.

ADVISORY SERVICES

Over a year ago, Syrianair requested from USAID the services of an aviation expert to work with the director of training to help plan future training activities. This request was finally cancelled in May 1980 because of the unavailability of such an expert within USAID's salary limitations.

It is recommended that this request be remade or that an expert be obtained from other sources to do the following in support of Syrianair's training manager. (These services might overlap future planned UNDP/ICAO activities and should be coordinated with them prior to finalizing actual tasks.)

- Review and evaluate the existent airline and related training activities in Damascus, in particular UNDP/ICAO plans for the future.

- Evaluate the manpower requirements for Syrianair in the areas of maintenance, cabin and cockpit service, ground handling, and other appropriate areas.

- Determine Syrianair's training needs in each area focusing on training content, facilities, and equipment required for an effective local program.

- Assign priorities to all training needs.

- Develop a long-range training plan and guidance in preparation of course syllabi.

- Recommend ways to upgrade ground-handling and passenger-service capability and the equipment needed. Also review fire and rescue squad operations and make recommendations as appropriate.

- Determine the feasibility of establishing a separate training facility for Syrianair.

The total length of assignment of this expert should be at least nine months, not necessarily continuously, but perhaps in two time periods. Results of this work combined with UNDP/ICAO inputs should provide Syrianair with the basic framework for their future training operations.

Finally, it is recommended that an expert experienced in the preparation of the various manuals required for both operations and training be recruited to start action on these manuals if not already covered in the UNDP follow-on program. It is estimated that it would take 12 man-months for such an expert to develop the needed manuals working with each department that requires them.

CHAPTER C-1

DEVELOPMENT PLAN PERFORMANCE -- AIR SECTOR

Chapter C-1

DEVELOPMENT PLAN PERFORMANCE - AIR SECTOR

This short chapter reviews the 4th Five-Year Plan for civil aviation and Syrianair. Table C-1.1 shows the details of commitments and achievements in the 4th Five-Year Plan as well as the amounts (expenditures) required for completion. Generally, both the Director General of Civil Aviation and Syrianair have few uncompleted projects or committed new projects to carry over into the 5th Five-Year Plan. Syrianair has no uncompleted committed projects to carry into the 5th Five-Year Plan, while DGCA has five at a total cost of about SP 47.5 million in 1981 and SP 3.5 million in 1982.

There are two projects that were in the 4th Five-Year Plan that have not been undertaken: Lattakia Airport improvement and a protocol building for Damascus. Lattakia Airport improvement is included in the projects for airport improvement in the next development plan.

A few other projects were started but are largely incomplete and can be considered uncommitted. These are:

- construction - Al Hassakeh air facilities,
- vehicle garage and equipment at Damascus,
- Damascus downtown terminal, and
- computer center for Syrianair.

It appears that projects undertaken in the 4th Five-Year Plan will be completed at close to the revised plan budgets. Major projects related to the Damascus terminal have been delayed and extend into the first two years of the next planning period, which explains the low percent of revised plan budget actually spent by the end of 1979.

Table C-1.2 summarizes the 4th Plan performance in the air sector. The table shows that the original plan budget of SP 335 million was revised to SP 396 million. By the end of 1979, about one-third of this amount had been spent, and it is expected that ultimately 73 percent of the total will be spent - 97 percent of the DGCA allocation and 49 percent of Syrianair's allocation. This reflects the exclusion of the Syrianair projects that are uncommitted that were noted earlier.

The previous figures do not include the unplanned expenditure of SP 258 million in 1976 for the purchase of B 747s and B 707s under a foreign aid grant. This cost was by far the dominant expenditure in the air sector during the plan period.

Table C-1.1

4TH AND 5TH 5-YEAR PLANS: EXPENDITURES AND REMAINING COMMITMENTS, CIVIL AVIATION AND SYRIANAIR

(SP 000)

	4th 5-Year Plan Estimate of Progress			
	Revised Plan Estimate	Expenditure Through 1979	1980 Estimate	Cost to Complete After 1980
A. Directorate General of Civil Aviation				
Complete Damascus Terminal	127,301	24,235	103,066	-
Airport Parking	8,823	4,323	4,500	-
Convert Old Passenger Terminal to Freight	1,000	-	-	1,000
Service Building - Damascus	-	-	-	1,000
Pavements - Aleppo	3,300	2,700	600	-
New Equipment & Accessories	12,304	5,229	7,075	-
Miscellaneous Airport Vehicles	3,000	5,244	2,000	-
Electronic Equipment	3,722	722	3,000	-
Construction Al Hassakeh [2]	9,000	135	500	8,000
High Level Radar[1]	11,500	-	-	11,500
B. Syrianair				
Training Center	14,600	70	210	14,320
Airport Equipment	6,382	6,382	4,000	-
Computer Center[2]	10,950	-	900	10,050
Equipment - 3rd Pier-Damascus	2,300	950	1,305	-

Table C-1.1 (Continued)

4TH AND 5TH 5-YEAR PLANS: EXPENDITURES AND REMAINING COMMITMENTS, CIVIL AVIATION AND SYRIANAIR

(SP 000)

	4th 5-Year Plan Estimate of Progress			
	Revised Plan Estimate	Expenditure Through 1979	1980 Estimate	Cost to Complete After 1980
B. Syrianair (Continued)				
Vehicle Garage & Equipment	3,000	-	-	3,000
Radio & Telephone Equipment	4,670	-	4,670	-
Equipment Damascus Terminal	55,000	505	2,000	52,495
Add to Aircraft Purchase	102,485	71,545	-	-
C. New Projects[3]				
Upgrade Lattakia	60,000	-	-	60,000
Protocol Building	25,000	-	-	25,000

Table C-1.1 (Continued)

4TH AND 5TH YEAR DEVELOPMENT PLAN: EXPENDITURES AND REMAINING COMMITMENTS, CIVIL AVIATION AND SYRIANAIR

(SP 000)

	5th 5-Year Plan						
	Adjusted Cost Completion - 5th 5-Year Plan						
	Consultants' Estimate		Distribution of Remaining Commitments				
	1980	After 1980	1981	1982	1983	1984	1985
A. Directorate General of Civil Aviation							
Complete Damascus Terminal	70,000	33,066	33,066	-	-	-	-
Airport Parking	-	4,500	4,500	-	-	-	-
Convert Old Passenger Terminal to Freight	-	1,000	-	1,000	-	-	-
Service Building - Damascus	-	-	-	-	-	-	-
Pavements - Aleppo	600	-	-	-	-	-	-
New Equipment & Accessories	7,075	-	-	-	-	-	-
Miscellaneous Airport Vehicles	2,000	-	-	-	-	-	-
Electronic Equipment	-	-	-	-	-	-	-
Construction - Hassakeh	100	8,400	-	-	-	-	-
High Level Radar[1]		11,500	10,000	1,500	-	-	-
B. Syrianair							
Training Center	-	-	-	-	-	-	-
Airport Equipment	4,000	-	-	-	-	-	-

Table C-1.1 (Continued)

4TH AND 5TH YEAR DEVELOPMENT PLAN: EXPENDITURES AND

REMAINING COMMITMENTS, CIVIL AVIATION AND SYRIANAIR

(SP 000)

5th 5-Year Plan

	Adjusted Cost Completion - 5th 5-Year Plan						
	Consultants' Estimate		Distribution of Remaining Committments				
	1980	After 1980	1981	1982	1983	1984	1985
B. Syrianair (Continued)							
Computer Center	900	10,050	-	-	-	-	-
Equipment - 3rd Pier - Damascus	1,305	-	-	-	-	-	-
Vehicle Garage & Equipment	-	-	-	-	-	-	-
Radio/Telephone Equipment	-	-	-	-	-	-	-
Equipment, Damascus Terminal[2]	2,000	-	-	-	-	-	-
Add to Aircraft Purchase	-	-	-	-	-	-	-
C. New Projects[3]							
Upgrade Lattakia	-	-	-	-	-	-	-
Protocol Building	-	-	-	-	-	-	-

Sources: 4th FYP, Government and Consultants' estimates.

1 Committed project.

2 Uncommitted project.

3 These projects were included in 4th FYP but were not undertaken and are uncommitted.

Table C-1.2

AIR TRANSPORT SECTOR - 4TH 5-YEAR PLAN PERFORMANCE

(000 SP)

	Original Plan Budget	Revised Plan Budget	Total Spent to End 1979	Percent of Revised Budget Spent	Estimated Cost to Complete Projects	Estimated Percent of Revised Budget Ultimately Spent
DGCA	126,300	199,923	52,596	26%	141,241	97%
Syrianair	208,842	196,417	78,502	40%	18,255	49%
Total	335,142	396,340	131,098	33%	159,496	73%

Sources: 4th Plan, Government estimates, and Consultants'estimates.

PART II

PIPELINES

CHAPTER A-1

SUMMARY AND RECOMMENDATIONS

Chapter A-1

SUMMARY AND RECOMMENDATIONS

INTRODUCTION

The bulk of crude oil and refined product commodities is transported across Syria in pipeline systems. Most systems are an integral part of a network designed to move both imported commodities and commodities destined for export. The network is currently used to transport the following commodities:

- Syrian and Iraqi crude oil between the source/border and refineries or exporting terminals located in Syria,

- Syrian refinery products between refinery and domestic distribution terminals or exporting terminals,

- Offshore crude oil and refined products between importing terminals and Syrian refineries or domestic distribution terminals, respectively, and

- Iraqi and Saudi Arabian crude oil between the Iraqi/Jordanian border and the Lebanese border.

The operation of the systems and the quantities of imports, exports, and domestic crude and product moved is discussed in Chapters A-3 to A-5. Economic analysis of pipelines is in Chapter A-6.

The overall coordination of the movement of commodities within the network is the responsibility of the Ministry of Petroleum and Mineral Resources. However, the actual operation and management of the network is divided among three public corporations, each of which is responsible for a particular segment of the network and the movement of specific commodities within the segment. These corporations are the Syrian Company for Oil Transport (SCOT), which is primarily responsible for transporting Iraqi crude oil; the Syrian Crude Oil Transport Company (SCOTRACO), which is primarily responsible for transporting Syrian crude oil; and the Syrian Company for Storage and Distribution of Petroleum Products (SADCOP), which is primarily responsible for transporting and selling refined petroleum products.

SCOT transports Iraqi crude oil through the 490 kilometer section of the 893 kilometer pipeline system that connects the Kirkuk oil field in Iraq with the export terminal at Banias and Tripoli. In addition, the company is responsible for maintaining the Tripoli line to the Lebanese border. The system interfaces with the SCOTRACO and SADCOP systems at Homs, Tartous, and Banias.

SCOTRACO transports Syrian crude oil through the 645 kilometer pipeline system that connects the Tal Addas oil field in northeastern Syria with the export terminal at Tartous. This system interfaces with the SCOT and SADCOP systems at Tartous, Banias, and Homs.

SADCOP transports the refined product from the Homs refinery through the 167 kilometer pipeline system to Damascus, the 166 kilometer pipeline system to Lattakia, and the 183 kilometer pipeline system to Aleppo.

A second international crude oil pipeline also runs through Syria, but it is not a part of the integrated network described above. The Trans-Arabian Pipeline Company (TAPLINE) pipeline from the Abu Hadriya fields in Saudi Arabia to the terminal at Saida in Lebanon consists of one pipeline with an annual capacity of about 25 million tons. Transportation of crude oil through this pipeline was discontinued in 1975.

Details concerning the existing and proposed infrastructure of each system in the integrated network are provided in the inventory tables included in Appendices A-1.1 through 1.5. A summary of the pertinent elements of each system is provided in the discussion that follows.

MAIN FINDINGS

Syrian Company for Oil Transport (SCOT)

This pipeline has ample capacity under present circumstances for delivering crude oil from Iraq to the Syrian port of Banias. There is also ample capacity to deliver crude in the opposite direction to Homs if this is required. In addition, the company supplies the distribution terminals at Banias and Homs with selected refined commodities for export, and it imports the same through the Banias terminal. Generally, equipment is adequately maintained and the operation procedures are adequate. Because there is excess capacity in the line, measures to increase throughput would be beneficial to Syria if tariffs at least covered the costs of operation or were above SP .015 per ton-kilometer.

Syrian Company for Storage and Distribution of Petroleum Products (SADCOP)

Pipelines undertake the main long-haul transport of refined petroleum products, with road and rail being used for local distribution and for long haul where present pipeline facilities do not have adequate capacity or where volumes are too low to justify a pipeline. Capacity is limited on the Homs-Aleppo

line. A new pipeline has recently been completed on the Homs-Adra route.

Maintenance and operation of the system appears satisfactory.

Consumption of petroleum white products has grown at over 9 percent per annum in the past decade and has been forecast to grow at 8 percent to 1985 and 5 percent between 1986 and 2000 to reach over 10 million tons by 2000.

Syrian Crude Oil Transport Company (SCOTRACO)

The system to deliver Syrian crude oil to Homs and Banias has ample capacity for current and expected needs unless there are major new oil discoveries in Syria in the future. The maintenance and operation of the line is adequate, although they are made more difficult by the high sulfur content of Syrian crude oil.

RECOMMENDATIONS

- SCOT should consider the possibility of improving the utilization of its pipeline through tariffs that will offer an economic advantage to Iraq to use the system while increasing overall returns to Syria.

- A detailed engineering and economic feasibility study should be carried out for the northeast region encompassing the following alternatives:

  1. Pipeline - Homs-Aleppo-Al Raqqa

  2. Pipeline - Homs-Al Raqqa and Homs-Aleppo

  3. Pipeline - Homs-Al Raqqa
     Rail - Homs-Aleppo

- A feasibility study should be undertaken for pipeline supply of petroleum products to Damascus Airport, a new distribution center in south Damascus, and a southern distribution point near Dera'a.

- Rail costs and capacities should be carefully monitored. Higher cost levels and capacity restrictions will have a significant impact on pipeline planning.

Subject to the results of these analyses, the Consultants have forecast the following product pipeline investments between 1985 and 2000:

- Homs-Adra, cost: SP 109,000,000.
- Homs-Al Raqqa direct, cost: SP 105,387,000.

CHAPTER A-2

ESTABLISHMENT

Chapter A-2

ESTABLISHMENT

GENERAL

The three general (that is, public) companies that operate pipeline systems in Syria are all attached to the Minister of Petroleum and Mineral Resources. The companies are:

- the Syrian Company for Oil Transport (SCOT),
- the Syrian Crude Oil Transport Company (SCOTRACO), and
- the Syrian Company for Storage and Distribution of Petroleum Products (SADCOP).

The Ministry of Petroleum and Mineral Resources has no separate organization for overseeing the operations of each of the companies. Each reports directly to the Minister. Coordination and supervision are provided by the Oil Affairs Board, which was created by Presidential Decree No. 9 of 13 January 1974. The board is chosen by the Minister, and its members are the Deputy Minister for Oil Affairs, the Syrian Oil Company (the oil exploration and production company), the Homs Refinery Company; and three members of the staff of the ministry who are nominated by the Minister. The Oil Affairs Board has the following formal functions:

- follows up the execution of work in the companies and coordinates the programs of production, transportation, refining, distribution, and export among them - in matters that do not contradict with the functions or duties of the State Planning Committee - to ensure the achievement of the goals of the production and investment plans,

- organizes the relations between the companies and settles disputes that may arise among them,

- studies the plans concerning the development of production in the companies and the economic and safe usage of the available resources, and ensures increases and sufficient production,

- assists the companies in setting plans that ensure the increase of exports and coordinates them with the production and consumption plan, and

- considers all matters that concern oil affairs.

The board has no secretariat, however, and it meets infrequently. It is not now functioning as an effective coordinating mechanism for the companies subordinate to the ministry, which report directly to the deputy minister, and there are no separate organizational elements charged with overseeing them. As a result, the pipeline operations are fairly independent, with coordination effected directly through contractual arrangements and other means and, to a degree, through investment planning.

The decrees establishing the three pipeline companies provide that they operate as merchants in relation with others. Thus, for example, SCOT has a contract with the Homs Refinery Company for the storage and delivery of Iraqi crude oil and imported oil to the refinery.

THE SYRIAN COMPANY FOR OIL TRANSPORT

The Syrian Company for Oil Transport (SCOT) was created on 1 June 1972 by nationalization of all the property inside Syria belonging to the Iraqi Petroleum Company. At the time of nationalization, SCOT was responsible only for the transport of Iraqi crude oil across Syrian territory and its export through the Banias terminal. However, when shipments of Iraqi crude were interrupted in 1976, the company's system was reconstructed to handle imports as well as exports. It delivered imported crude oil to the Homs Refinery Company and it is currently responsible for handling imports of selected refined products for SADCOP.

SCOT has retained the basic organization structure and management principles that were in place at the time of nationalization. It is a well-managed company and has provided some technical advice and service to SCOTRACO since the latter's formation in 1974.

The organization of SCOT is shown in Figure A-2.1. The company is organized into an operations directorate and three support directorates. The Engineering and Operations Directorate operates and maintains the pipeline system, the terminal, the buildings and grounds, and allied telecommunications and instrumentation. It also provides security service. The directorate is divided into eight departments, as shown in Figure A-2.1.

THE SYRIAN COMPANY FOR STORAGE AND DISTRIBUTION OF PETROLEUM PRODUCTS

The Syrian Company for Storage and Distribution of Petroleum Products (SADCOP) was one of four petroleum companies formed by Presidential Decree No. 9 of 13 January 1974. (The other three

are the Syrian Oil Company, SCOTRACO, and the Homs Refinery Company.) Its basic responsibilities are:

- to construct storage tanks and lay pipelines for petroleum by-products and gas and to operate them,

- to take necessary measures to secure the country's requirements for petroleum by-products,

- to market petroleum by-products domestically, and

- to establish centers and stations for selling petroleum by-products.

To fulfill these responsibilities, SADCOP is organized as shown in Figure A-2.2. There are eight directorates, four operational and four support, and regional branch directorates. Two of the operational directorates have the principal responsibility within SADCOP for transport.

The Petroleum Operations Directorate has responsibility for transport of all products except bottled gas.

THE SYRIAN CRUDE OIL TRANSPORT COMPANY

Decree No. 9 states that the Syrian Crude Oil Transport Company (SCOTRACO):

> carries out all the work and duties that concern the transportation of Syrian crude oil, particularly:
>
> 1. Construction of storage tanks and pipelines and operating them.
>
> 2. Transport of crude oil to the oil refineries and the export ports.
>
> 3. Construction of ports for the export of crude oil, operation of those ports and provision of maritime services to the carriers.

The company replaced the Directorate of Crude Oil Transport in the Syrian General Company for Oil, and subsequent to its formation, it came under the purview of Decree 18 of 1974. The company operates pipelines from the oil fields at Karthok and Jabseh to the refinery at Homs; to the oil terminal at Tartous, which the company also operates; and more recently to the SCOT pipeline system at Tartous for onward delivery to the new refinery at Banias.

Figure A-2.1

SYRIAN OIL TRANSPORT COMPANY

(SCOT)

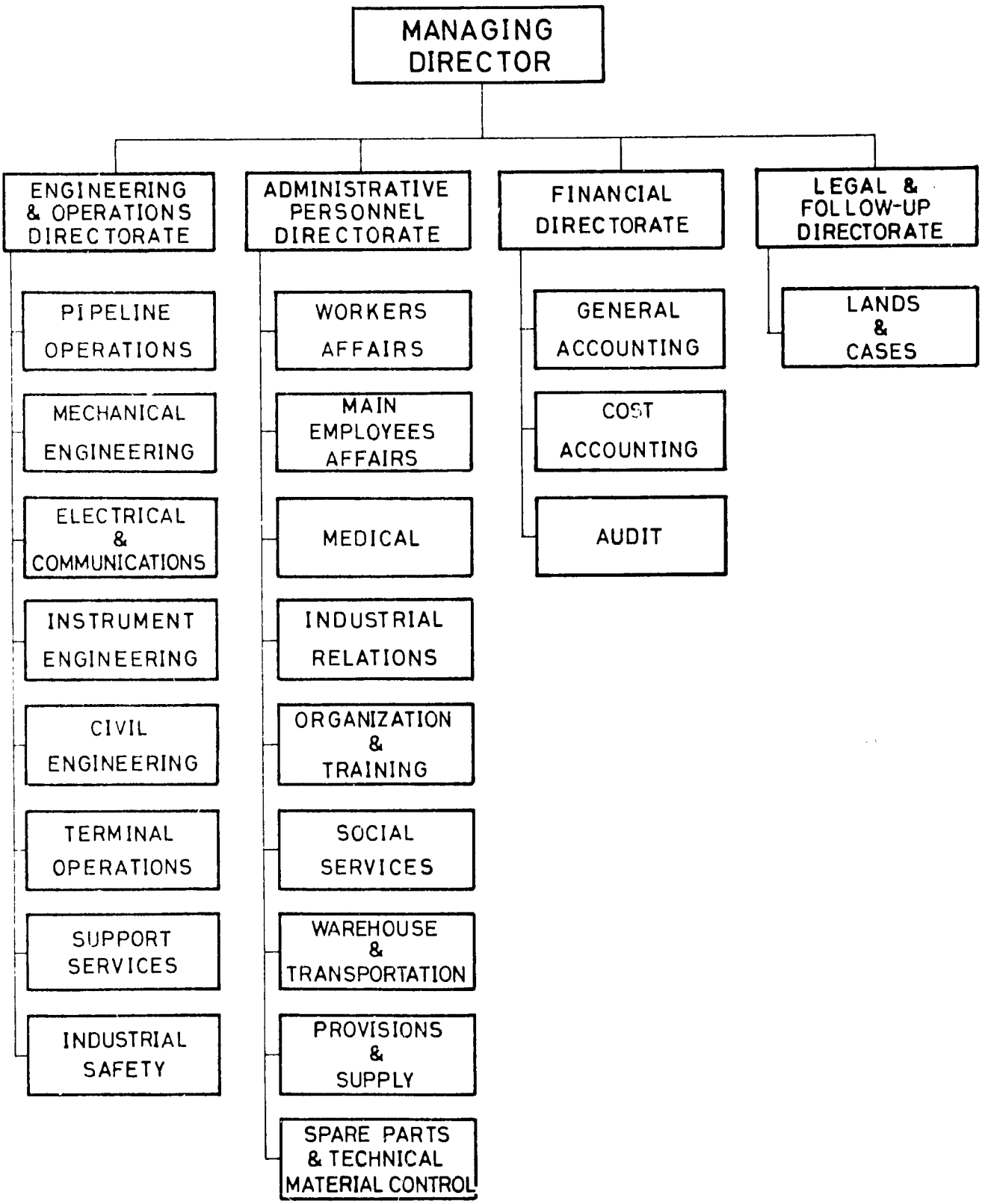


Figure A-2.2

ORGANIZATION OF THE SYRIAN COMPANY FOR STORAGE AND DISTRIBUTION OF PETROLEUM PRODUCTS (SADCOP)

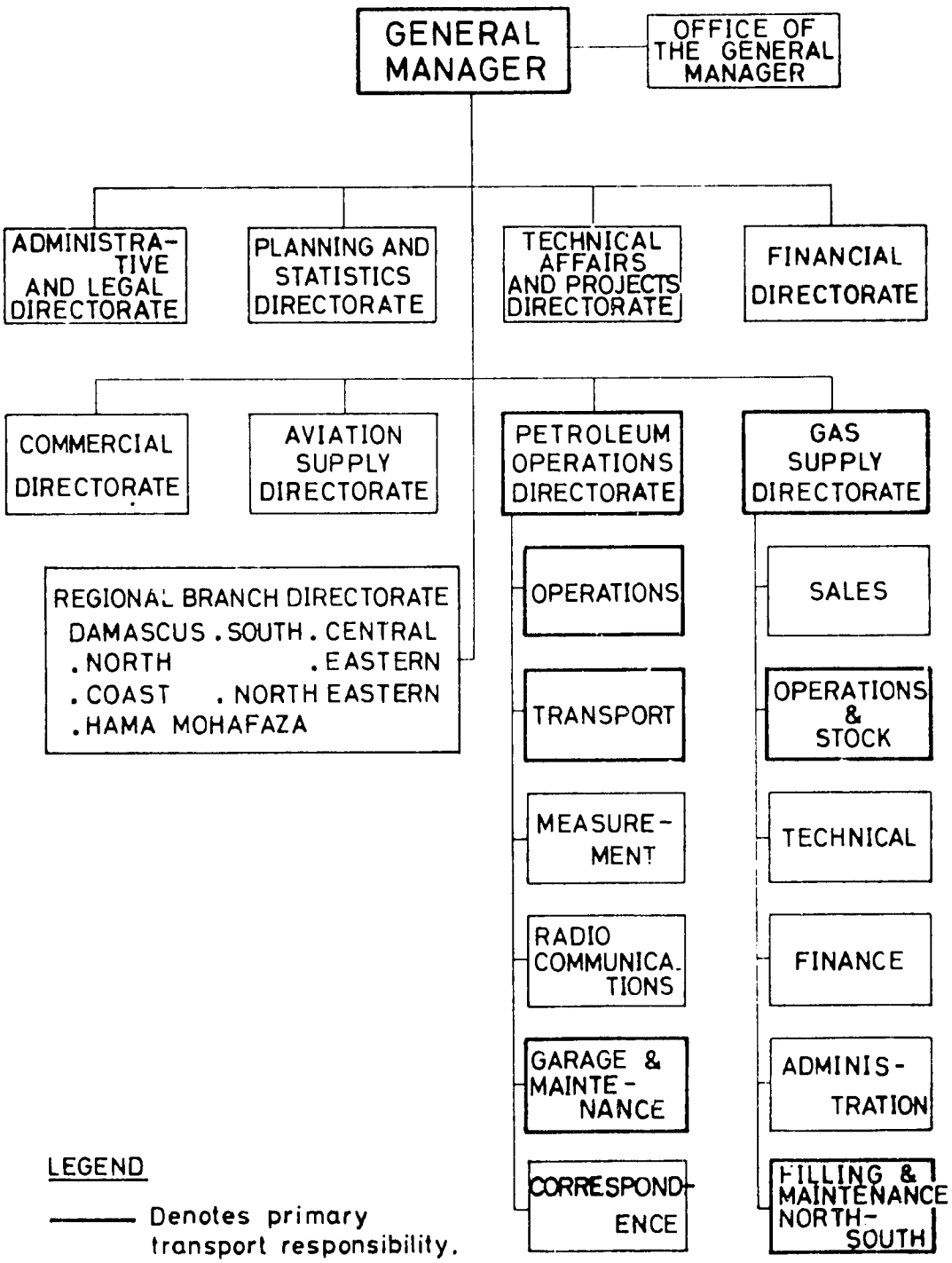
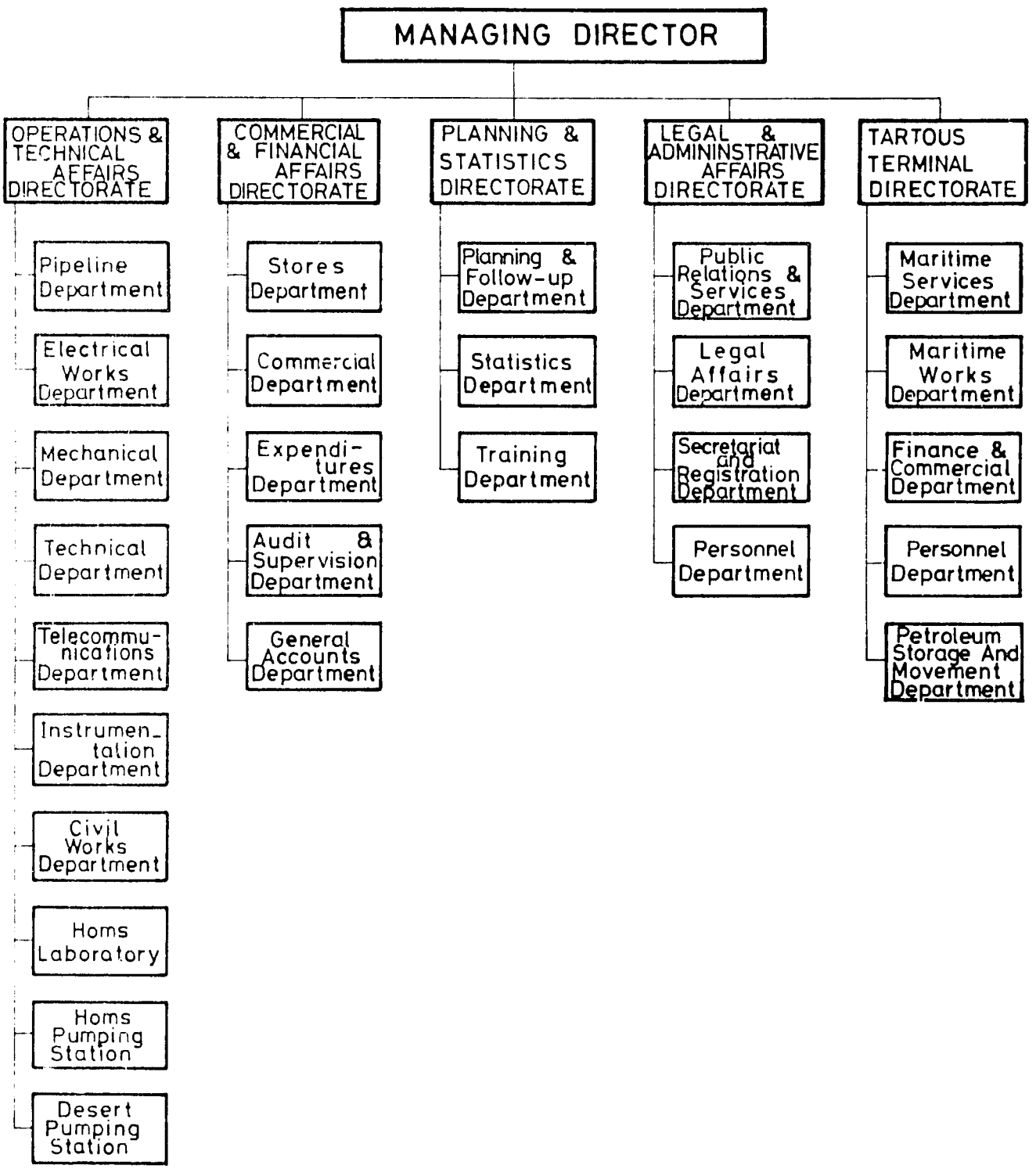


Figure A-2.3

SYRIAN CRUDE OIL TRANSPORT COMPANY

(SCOTRACO)



The present organization of SCOTRACO is shown in Figure A-2.3. Although titles are different in some cases, the organization closely parallels that of SCOT, as might be expected. With one exception, all operations and maintenance are incorporated in a single Operations and Technical Affairs Directorate. The exception is Tartous Terminal, which is a separate directorate. In SCOT, terminal operations are a department within the Engineering and Operations Directorate. The differences can be justified in part by the physical separation, with SCOTRACO's headquarters in Homs and the terminal an independent operation at Tartous. In the case of SCOT, these functions are all physically located at Banias.

CHAPTER A-3

SYRIAN COMPANY FOR OIL TRANSPORT (SCOT)

Chapter A-3

SYRIAN COMPANY FOR OIL TRANSPORT (SCOT)

INFRASTRUCTURE

The delivery system covers approximately 500 kilometers and includes over 2,000 kilometers of pipeline, 3 pumping stations, 1 bifurcating manifold (mile 494), 2 storage facilities, 1 pumping station, 15 kilometers of sea lines, and 5 sea berths.

The description of the system begins at the Syria/Iraq border, which is mile 250 of the Iraqi crude oil delivery system that originates at the Kirkuk field in Iraq. Four pipelines cross the border near Albu Kamal. At this location, there are two 760/812 millimeter (30/32 inch) diameter pipelines and one 305 millimeter (12 inch) diameter pipeline that carry crude oil from the Kirkuk field and one 406 millimeter (16 inch) diameter pipeline that carries fuel gas from Bai Hassan or Jambur.

The fuel gas is distributed to three of the system's desert pump stations (T-2, T-3, and T-4) located at distances of 47 kilometers, 177 kilometers, and 275 kilometers from the border (miles 279, 360, and 421 of the system), respectively. The 406 millimeter (16 inch) pipeline is interconnected to the other three at the third pumping station at Km 275 and is used to transport crude oil from this location westward.

The highest elevation in the system is located 384 kilometers from the border (mile 466 of the system). At this location on the Banias line one of the 760/812 millimeter (30/32 inch) diameter pipelines bifurcates into a 610 millimeter (24 inch) diameter and a 660 millimeter (26 inch) diameter pipeline.

The Homs refinery off-take and storage facility are located 375 kilometers from the border (mile 480 of the system). The system from the border to Homs is used exclusively to transport Iraqi crude oil. The system between Homs and Banias (121 kilometers) is currently designed to transport crude oil and/or refined product commodities in either direction, depending on the availability of supply and the magnitude of the demand. (The operating alternatives are discussed in a later section of this report.) A description of the infrastructure between Homs and Banias follows.

The system at mile post 494 consists of the five parallel pipelines described previously, with the 610 millimeter (24 inch) line looped to make a total of six lines at this manifold. The remaining 760 millimeter (30 inch) diameter pipeline also bi-

furcates into a 610 millimeter (24 inch) diameter and 760 millimeter (30 inch) diameter pipeline 393 kilometers from the border (mile 194 of the system). The 760 millimeter (30 inch), 410 millimeter (16 inch), and 305 millimeter (12 inch) pipelines branch off to the Lebanese border and the Port of Tripoli; two 610 (24 inch) diameter and one 660 millimeter (26 inch) diameter pipelines go north to the storage facilities and export terminal at Banias.

The system interfaces with the SCOTRACO system at Tartous through a 457 millimeter (18 inch) diameter off-take, crossover and 540,000 cubic meter storage facility. The system also interfaces with SADCOP at Banias through the storage facility, the refinery, and the associated pumping facilities.

The storage facility at Banias consists of 34 tanks with a capacity of 850,000 cubic meters. In addition, crude oil and refined products are exported and/or imported at Banias through tankers moored offshore by way of five 610 millimeter (24 inch) diameter pipelines; eight 610 millimeter (24 inch) diameter sea lines; and five sea berths.

Ongoing Projects

Four new jet fuel storage tanks are currently under construction at the Banias storage facility. Each tank has a nominal capacity of 15,000 cubic meters. When the jet fuel tanks are completed, the Banias storage facility will have a total capacity of 910,000 cubic meters.

In addition, another 13 new tanks are under construction at Homs to store products from the Banias refinery that will be transported to Homs through the company's own pipelines. These commodities will then be redistributed through the SADCOP system. The 13 new tanks will have a capacity of 256,123 cubic meters.

Development Plans

Major expansion plans are proposed at Banias and Homs to transport and/or to store refined product from the new Banias refinery. A brief description of the major additions to the system follows.

The plans for Banias include the expansion of offshore sea lines and berthing facilities and the addition of a second 610 millimeter (24 inch) sea line to each of two berths currently connected to shore by a single sea line each. In addition, an entirely new berth is proposed for the export and import of jet fuel and LPG. This will be accomplished through ten new sea lines with diameters ranging from 14 inches to 24 inches.

The plans for Banias also include the construction of two truck loading stations, one each for handling white products and heavy fuels.

Additionally, Banias is scheduled to receive a mechanical and electrical network to tie-in all expansion projects including pump sets and a computer for the control center.

The plans for Homs include the construction of 13 new tanks to store product from the Banias refinery to be transported to Homs through SCOT pipeline system for redistribution through the SADCOP system. The new tanks at Homs will increase the storage capacity at Homs by over 255,000 cubic meters. One truck-loading station for handling white products is also scheduled for construction at Homs.

Evaluation

The pipeline infrastructure has been steadily altered to accommodate changes in supply and demand of crude oil and refined products. This is most evident west of Homs, where reverse flow under pressure has been built into the system to accommodate a change in the source of oil for the Homs refinery. Other changes have been recently made to accommodate the transport of crude oil to meet the needs of the Banias refinery and the transport of product from the refinery before export or distribution.

Such changes may continue in the future. However, it appears that given existing conditions, such changes will be minor as the alternatives for changes diminish. The discovery of new oil fields in Syria or in neighboring countries is the only major change that could dramatically affect the need to alter the existing infrastructure. Insufficient data are available regarding the potential development of new resources. Such data are a prerequisite to developing alternative plans for adding new infrastructure to the existing network.

OPERATIONS

The segment of the pipeline network operated by SCOT has undergone significant operating changes since the 1930s and 1940s. Originally, the pipeline served to transship Iraqi crude oil across Syria. The system was expanded in the 1950s with the addition of two parallel pipelines and the construction of an export terminal at Banias. In the 1960s an off-take system was added at Homs when the refinery was constructed. Reverse flow between Banias and Homs was built into the system in the 1970s for delivery of imported crude oil to Homs when Iraqi crude oil deliveries were discontinued. Plans are currently being formu-

lated to accommodate the new refinery operations at Banias. These plans include the delivery of Syrian crude oil from Tartous and the reverse pumping of refined products from Banias to the new storage facility at Homs.

The effectiveness of these changes depends on the proper maintenance, operation, and capacity of the delivery system.

Infrastructure Maintenance

The pipelines, pumps, storage tanks, and sea berths vary markedly in age. Only the 305 millimeter (12 inch) pipeline constructed in 1934 is not operational. This line was constructed before anticorrosive materials were perfected; approximately 100 kilometers of the 305 millimeter pipeline are badly corroded in the salt-laden desert reaches between pump stations three and four.

Iraqi crude oil is not currently being transported to Lebanon; thus, the branch line to Lebanon is also not in use at this time. However, this is unrelated to the maintenance aspects of the network.

The major gas turbine engines that transport the oil through this system have between 10,000 and 120,000 hours of use. These pumps and back-up systems require only routine and periodic maintenance and overhaul. No major replacements are anticipated in the near future.

The storage tanks are inspected and maintained regularly, as are the sea lines, berths, and mooring buoys that receive preventive maintenance care at regular intervals.

The supporting maintenance equipment and personnel are sufficient to keep the network operating at a high rate of efficiency.

Operating Procedures

The company maintains a full service organization to insure the least cost and highest efficiency for the transport of crude oil and refined product through the system. Operations are the primary responsibility of the Engineering and Operations Directorate. The directorate provides engineering, maintenance, planning, and safety services. It also operates the pumping units at the three desert stations and at Banias; the telephone and radio telecommunications system; the instrument and measuring equipment at all stations; and the storage and loading facilities at Banias.

Capacity

The capacity of the delivery system varies in different parts of the system. The capacity between the Syria/Iraq border and the Lebanese/Banias division is 1.4 million barrels per day (approximately 68 million tons per year). The flow in 1979 was about 260,000 barrels per day, or 19 percent of the existing capacity. The capacity of the active delivery system to Banias is approximately 60 percent of the total, or 41 million tons per year. The current annual rate of export of Iraqi crude oil is approximately 10 million tons, based on the first six months of operation in 1979. Iraqi crude oil shipments were discontinued in April 1976 until February 1979.

The capacity of the reverse flow in the newest of the 610 millimeter (24 inch) diameter pipelines is 16,000 tons per day. In 1979 this line was used to pump about 2,700 tons per day of gas oil between Banias and Homs, or 17 percent of the reverse flow capacity. This rate is reported as being lower because of power limitations.

Evaluation

The existing system is adequately maintained to fulfill its mission of delivery of crude oil and refined product at least cost. The operating procedures have been reviewed and were found to be adequate to meet the current demands. In addition, present operations do not result in delays in loading carriers, which is a measure of the efficiency of the system. Under present circumstances, the existing system is operating at 20 percent of capacity. It is estimated that the new refinery at Banias could require an additional 25 percent of the system's capacity when it comes into full production. Therefore, the existing system is adequate to handle the demand under present and anticipated conditions.

TRAFFIC

SCOT has experienced a widely fluctuating traffic flow over the past decade (see Table A-3.1). Between 1976 and 1979, no Iraqi crude was flowing in the system. Because of the requirements for crude at the Homs refinery, a reverse flow of about 2.5 million tons per year between Banias and Homs was established. In early 1979, shipments of Iraqi crude for export were resumed through Banias at a rate of about 10 million tons per year, with Homs refinery requirements of about 2.5 million tons being met by Iraqi crude. Thus, current traffic flows are approximately as follows:

- Syria/Iraq border-Homs (crude) 12.5 million tons
- Homs-Banias (crude) 10.0 million tons
- Banias-Homs (gas oil) 1.0 million tons

Table A-3.1

SYRIAN COMPANY FOR OIL TRANSPORT TRAFFIC 1970-1979

(in million tons)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Iraq Crude	30.1	27.4	24.2	29.2	22.4	26.6	--	--	--	4.2[a]
Crude Imports (Banias-Homs)	--	--	--	--	--	--	2.5[b]	2.5[b]	2.5[b]	--
Gas, Oil Imports (Banias-Homs)[c]	--	--	--	--	1.4	1.0	1.3	0.8	1.0[b]	--

The following quantities represent 1980 estimated traffic:

Iraqi Crude Export/Banias	10.000	million tons
Iraqi Crude Refineries Demand	5.000	"
Syrian Crude Transport Tartous-Banias	1.000	"
Refined Product Import Banias	0.800	"
Refined Product Export Banias	2.225	"
Refined Product Transportation Banias-Homs	0.600	"

Sources: Syrian Company for Oil Transport and Consultants' estimates.

a March-August.

b Estimated.

c Based on all imports being moved by pipeline Banias to Homs.

As pointed out in the section on capacity, the current traffic uses only about 20 percent of capacity. Future traffic could therefore increase four or five times over the section from the Syria/Iraq border to Homs and three to four times on the delivery system to Banias. Future demand expectations in Syria will use some of this excess capacity, possibly doubling Syrian offtake at Homs in the next ten years.

It is clear, however, that it would be in Syria's interest to attract greater usage of the pipeline. Attractive tariffs based on the fact that the pipeline capacity has no alternative use could be worked out. This would mean developing a tariff related to the marginal cost of operation of the line with the specific objective of inducing more Iraqi crude export through Syria. It should be pointed out that Syria should not place the tariff at such a level as to use all of the line's capacity and thus remove the capability to back pump gas oil through the line from Banias to Homs. In practical terms, capacity should be reserved for Syrian needs as marginal cost tariffs on crude from Iraq would not be sufficient to pay for a new pipeline from Banias to Homs if the present line became capacity restricted as a result of incentive rates.

Given the available cost data, a mutually beneficial tariff to both Syria and Iraq would be between SP .015 and .03 per ton-kilometer. A tariff based on a new pipeline including full cost recovery could be as high as SP .04 per ton-kilometer based on recent cost estimates for pipeline construction and operation in Syria.[1]

COSTS

Because of the interruptions in oil flow through the SCOT pipeline over the past few years, the cost of operation can only be generalized on the basis of limited data for 1978 and 1979. It appears from available financial data that costs did not drop markedly during the interruption of traffic, particularly salary and wage costs. Clearly, pumping costs were not incurred, but other costs remained, no doubt in the expectation of the resumption of traffic, which in fact has occurred.

The tariffs now being charged and established in early 1979 are within these cost parameters. The tariff for shipping crude inland from Banias to Homs has been set at SP 5.35 for transport,

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[1] Products Distribution Network Conceptual Design, Williams Brothers Engineering Company, 1977.

or 4.28 piasters per ton-kilometer. This appears to be close to a fully compensatory rate that would include capital recovery. For the transport of Iraqi crude from the Syria/Iraq border to Homs, the tariff is SP 7.88, or about 2.1 piasters per ton-kilometer. This rate will more than cover apparent operating costs. Any proposed tariff changes will have to take into account the alternative, competing lines through Turkey.

CHAPTER A-4

SYRIAN COMPANY FOR STORAGE & DISTRIBUTION OF PETROLEUM PRODUCTS (SADCOP)

Chapter A-4

SYRIAN COMPANY FOR STORAGE & DISTRIBUTION OF PETROLEUM PRODUCTS (SADCOP)

INFRASTRUCTURE

The existing refined product pipeline delivery system covers over 500 kilometers and includes 680 kilometers of pipeline, 8 pumping stations, 4 storage facilities, 6 kilometers of sea lines, and 2 sea berths.

Damascus, Aleppo, and Lattakia are each served by pipelines from Homs. The infrastructure at Homs that supports the three pipelines consists of a pumping station and storage facility. Only petroleum products transported from the refinery are stored. The other storage tanks are managed by the Homs Refinery and SCOTRACO.

The pumping station at Homs is administered by SADCOP and consists of two electric pumping units for the Damascus and Aleppo pipelines, one working electric pumping unit for the Lattakia pipelines, and three stand-by pumps, one for each unit.

The storage facility at Homs has a capacity of 60,000 cubic meters of refined product. The Damascus and Aleppo pumps have a capacity for pumping 100 cubic meters of product per hour, and the Lattakia pump has a capacity for pumping 60 cubic meters of refined product per hour.

The three pipelines, auxiliary pumps, and terminal facilities are described below.

Homs-Adra (Damascus area)

Gasoline, gas oil (diesel), and kerosene are transported 167 kilometers from Homs to Adra through a 150 millimeter (6 inch) diameter pipeline. Auxiliary diesel pumps are located 40 kilometers and 96 kilometers from Homs to boost the head to overcome friction losses in the pipeline en route. There are 15 storage tanks located at Adra. These include nine tanks with a total capacity of 45,000 cubic meters that are used to store diesel oil and an additional six tanks with a total capacity of 27,000 cubic meters that are used to store either gasoline or kerosine.

Homs-Aleppo

Refined products are transported 183 kilometers by a 150 millimeter (6 inch) diameter pipeline between Homs and Aleppo.

Two supporting pumping stations serve this link. One pump is electric and is located 46 kilometers from Homs; the second pump is diesel and is located 93 kilometers from Homs. There are 12 tanks with a total capacity of 55,200 cubic meters used to store diesel oil; 6 tanks with a storage capacity of 13,000 cubic meters used to store two kinds of gasoline; and 7 tanks with a total capacity of 12,000 cubic meters for kerosine storage.

Homs-Lattakia

The Homs-Lattakia refined product 150 millimeter (6 inch) diameter pipeline operates in both directions over the 166 kilometer distance between the terminals and is linked to the Banias terminal. With the Banias link, different segments of the pipeline can be operated in the same flow direction or opposite flow directions simultaneously with the same or different products.

Three pumping stations permit this operational flexibility. Each station has two working diesel pumps and one stand-by pump. The stations are located at Tartous, Banias, and at the Lattakia terminal. The pumping capacity of the Lattakia station is 90 cubic meters per hour.

The storage facilities at Lattakia include 8 tanks with a total capacity of 46,000 cubic meters that are used to store gasoline; two tanks with a total capacity of 15,000 cubic meters used to store jet fuel; two tanks with a total capacity of 7,000 cubic meters used to store diesel; and 8 tanks with a total capacity of 12,000 cubic meters to store lubricants.

Other facilities at Lattakia include three 200 millimeter (8 inch) diameter sea lines and one 305 millimeter (12 inch) diameter sea line. One of the 200 millimeter sea lines was not in working order at the beginning of 1980. All the sea lines are connected to the same sea berth. Gasoline is imported through the sea lines at variable rates depending on the capacity of the tanker delivering the product.

Naptha is exported at Banias through the SCOT sea lines, and diesel is imported through the Banias facility.

New Projects

A new 305 millimeter (12 inch) pipeline and three electric pumps have recently been constructed to boost capacity of the Homs-Adra refined product delivery system. The new pipeline parallels the existing 150 millimeter diameter pipeline and commenced operations in early 1980.

Development Plans

Expansion of the refined products delivery system to Aleppo and the northeast sector of Syria is required to meet the probable future demand for product in these regions. The Ministry of Petroleum and Mineral Resources has plans to study the construction of a parallel pipeline between Homs and Aleppo similar to the one under construction between Homs and Adra. The railway is proposing a similar study to examine the potential for increasing the railway tank car fleet to fulfill this transportation need.

In the future, a pipeline system may also be required to service the northeast region of Syria to meet the growing demand for refined products in this region.

Evaluation

Refined products are currently transported by pipeline, truck, and railway tankers. The pipeline dominates the long-haul transportation requirements, while trucks undertake most of the distribution from the main pipeline terminal points. Railways carry a fraction of the product. The adequacy of the infrastructure is analyzed further in Chapter A-6.

OPERATIONS

The demand for refined products has grown rapidly over the past decade (see Table A-4.1). This has required a steady growth in the distribution network and also a shift in the network to reflect the changes in regional demand for refined products. Regional demand for gasoline and diesel between 1974 and 1978 is shown in Table A-4.2. The significance of these changes in regard to pipelines follows.

Infrastructure Maintenance

The refined products pipeline distribution system is relatively new, having been completed in the mid-1960s upon completion of the Homs refinery. The major elements of the system, that is, pipelines, pumps, and storage tanks, are maintained by SADCOP personnel in contrast to new capital investment projects, which are undertaken by construction contractors.

The only element of the system that has been abandoned is a 200 millimeter (18 inch) diameter sea line at Lattakia. It is reported that the major 150 millimeter (6 inch) diameter pipeline has been damaged by vehicles crossing the line. All elements of the system receive annual and periodic maintenance; for example, storage tanks are continually undergoing reconditioning and repair.

Table A-4.1

GROWTH CONSUMPTION OF PETROLEUM PRODUCTS

(000 tons)

Year	Gasoline[1]	Kerosine	Diesel	Fuel Oil	Jet Fuel	Butane Gas	Asphalt	Total
1960	72	82	433	288	-	5	19	899
1965	117	125	681	393	10	10	29	1,365
1970	196	171	950	587	94	20	86	2,004
1971	212	183	1,035	652	90	24	88	2,284
1972	251	210	1,189	735	113	29	102	2,629
1973	281	207	1,253	621	157	28	58	2,605
1974	332	236	1,563	561	168	34	83	2,977
1975	399	264	1,758	544	204	39	87	3,295
1976	456	296	1,944	487	219	51	109	3,562
1977	482	285	1,981	603	192	59	171	3,773
Growth Rate (%)								
1960-65	10	9	9	6	-	15	9	9
1960-67	11	8	7	7	-	15	16	8
1970-77	14	8	13	-	11	17	10	9

Source: SADCOP, Damascus.

1 Includes Regular and Super.

Table A-4.2

REGIONAL DISTRIBUTION OF CONSUMPTION

OF DIESEL AND GASOLINE, 1974-1978

(000 metric tons)

Mohafaza	1974	1975	1976	1977	1978
Damascus City & Mohafaza					
Gasoline	104.6	89.1	144.4	164.7	157.5
Diesel	460.7	496.0	415.7	371.6	440.0
Dera'a					
Gasoline	5.6	7.7	11.3	18.3	18.7
Diesel	34.9	42.1	64.6	63.9	85.5
Al Suweida					
Gasoline	2.7	3.6	4.6	4.7	3.7
Diesel	18.9	18.8	22.0	14.5	19.3
Homs					
Gasoline	25.4	30.6	33.6	31.3	32.1
Diesel	129.7	149.7	164.6	287.9	209.5
Lattakia					
Gasoline	12.0	14.9	19.1	20.5	25.1
Diesel	59.0	83.1	95.8	77.6	80.7
Tartous					
Gasoline	9.0	11.8	15.0	15.7	17.3
Diesel	39.6	58.9	72.2	76.6	80.8
Hama					
Gasoline	16.0	18.8	25.0	26.3	28.2
Diesel	94.6	124.2	126.1	132.0	133.1
Idleb					
Gasoline	5.7	7.1	9.8	11.4	13.3
Diesel	66.3	78.9	111.0	112.0	111.6

Table A-4.2 (Continued)

REGIONAL DISTRIBUTION OF CONSUMPTION

OF DIESEL AND GASOLINE - 1974-1978

(000 metric tons)

Mohafaza	1974	1975	1976	1977	1978
Aleppo					
Gasoline	49.6	56.6	68.4	70.5	73.1
Diesel	368.1	342.3	366.5	368.4	423.1
Al Raqqa					
Gasoline	8.7	12.5	13.4	13.2	14.8
Diesel	59.2	73.4	72.2	84.4	86.5
Deir Ez Zor					
Gasoline	5.7	7.9	9.8	8.6	9.7
Diesel	69.6	78.1	86.8	79.5	75.9
Al Hassakeh					
Gasoline	8.2	18.8	23.9	23.8	25.3
Diesel	134.9	124.3	151.2	166.1	151.2

Source: SADCOP, Planning and Statistics Division, Damascus.

Notes: Gasoline includes regular and super.

The totals of the region are slightly less than the totals in Table A-4.1.

Operating Procedures

Homs is the major terminal for SADCOP distribution by pipeline. The refined products are received from SADCOP's own storage facilities or from those of the Homs Refinery. The system is also used to transport imports received through the terminal at Lattakia. Gasoline from this terminal is transshipped through the Homs-Lattakia 150 millimeter diameter pipeline to Homs for storage and/or direct redistribution.

Capacity

The capacities of the different elements of the system are provided in the inventory tables. (These tables are found in Appendices A-1.1 through A-1.5 of the Final Phase I Report.) In summary, the pipeline capacity is about 600,000 tons per year between Homs and Adra, 605,000 tons per year between Homs and Aleppo; and 550,000 tons per year between Homs and Lattakia. The storage capacity is 72,000 cubic meters at Homs; 72,000 cubic meters at Adra; 8,000 cubic meters at Aleppo; and 74,000 cubic meters at Lattakia. The average pumping rate at Homs is 100 cubic meters per hour for the Adra and Aleppo systems and 60 cubic meters per hour for the Lattakia system; and the average pumping rate at Lattakia is 90 cubic meters per hour for the reverse flow to Homs in the operational 12 inch line and 300 cubic meters per hour through the sea line to tanker berths. There is a pumping station at Homs that consists of two pumps and one supporting pump.

The new 305 millimeter pipe between Homs and Adra will move an additional 650,000 tons of refined product per year, and the pumping rate of the new units is 160 cubic meters per hour. The total capacity of the Homs-Adra lines can be increased by adding additional pumping capacity.

Evaluation

An evaluation of present and future pipeline capacities and requirements is found in Chapter A-6, below.

CHAPTER A-5

SYRIAN CRUDE OIL TRANSPORT COMPANY (SCOTRACO)

Chapter A-5

SYRIAN CRUDE OIL TRANSPORT COMPANY (SCOTRACO)

INFRASTRUCTURE

The Syrian crude oil delivery system covers 660 kilometers between the Tal Addas oil field and the exporting terminal at Tartous. The system includes [illegible] kilometers of pipeline, 10 pumping stations, 4 storage facilities, 5 kilometers of sea lines, and 2 sea berths. A brief description of the major elements of the infrastructure follows.

Tal Addas, Homs, and Tartous are the major terminals of the system. Tal Addas is located at the source, and Homs and Tartous are destination points. Sixteen storage tanks with a capacity of 300,000 cubic meters are located at Tal Addas. A 560 kilometer-long 560 millimeter (22 inch) diameter pipeline lies between Tal Addas and Homs. There are nine intermediate pumping stations and accompanying pressure relief loops located between Tal Addas and Homs. The location of the pumping stations, as well as the length and diameter of the pressure relief loops, are summarized in Table A-5.1.

In addition, there is a small storage facility at Al Raqqa that consists of two tanks that have a total capacity of 40,000 cubic meters. The system at Homs includes the mainline pump station previously noted; a refinery off-take system; and an 11-tank storage facility with a capacity of 160,000 cubic meters.

The 86 kilometers between Homs and Tartous are covered by twin 455 millimeter (18 inch) diameter pipelines.

The system at Tartous includes a 24-tank storage facility with a 540,000 cubic meter storage capacity, a crossover connection to the SCOT system, two pipelines, three 710 millimeter (28 inch) sea lines, and two sea berths connecting the storage facility with offshore tanker terminals.

ONGOING PROJECTS

Major system expansions were completed during the early years of the current five-year plan. The overall effect of expansion projects was to increase the capacity of the system by over 60 percent. Projects consisted of the construction of a second parallel pipeline between Homs and Tartous and four new pumping stations between Tal Addas and Homs.

Ongoing projects at the end of the plan period will include the construction of four new storage tanks at Tal Addas and three new storage tanks at Tartous.

Table A-5.1

PUMP STATIONS AND PRESSURE RELIEF LOOPS

Station Location	Km	Length of Loop (kms)	Diameter mm	Diameter in.
Tal Addas	0	5.0	560	(22)
Tal Yarak	89	9.3	560	(22)
Tal Baida	156	14.8	560	(22)
Sabah El Kheir	233	0.7	560	(22)
Al Raqqa	299	5.4	560	(22)
Rassafeh	367	17.2	560	(22)
Atharela	424	6.7	560	(22)
Al Salamieh	482	8.8	560	(22)
Homs	559	20.0	560	(22)

Source: SCOTRACO.

Development Plans

Crude oil production has declined following the substantial expansion in the capacity of the system in 1976/1977; the existing system thus operates below capacity. There are no new development plans formulated at present. Such plans will depend on new discoveries of oil reserves and/or changes in the arrangements for transporting oil between Syria and its neighbors.

Evaluation

The existing system is adequate to transport current and projected productions of crude oil from the existing proven reserves in Syria. Exploration is currently underway or programmed in areas adjacent to the existing pipeline but no significant discoveries have been made. Alterations to the existing system could be made to accommodate limited crude oil production in the event of new discoveries. There is also exploration potential in areas unrelated to the existing system, such as offshore near Lattakia. Discovery in such areas would require new facilities to transport Syrian crude oil.

It is also possible that the Syrian crude oil system could be extended to the Iraqi border in the future and used to transport Iraqi crude produced in this region.

OPERATIONS

SCOTRACO is responsible for insuring the safe and continuous flow of Syrian crude oil from the production areas to the refinery and the export terminals at Tartous. The actual quantities transported and the period of operation are a function of supply and demand and are basically beyond the control of the company. Therefore, the operations of the pipeline and pumping station are not always efficient. The limited control the company has is exercised through operation of the storage facilities and the terminal facilities at Tartous.

Infrastructure Maintenance

Routine and periodic maintenance of the pipeline, pumps, storage tanks, and sea berths are special problems for SCOTRACO because Syrian crude oil is a heavy crude that contains a high sulfur content. This high level tends to shorten the life of infrastructure facilities even when the facilities are properly maintained.

This problem was illustrated during the inventory of storage tanks. The results of the inventory show that 5 out of 12 storage tanks at Tal Addas, 4 of 11 at Homs, and 4 of 17 at Tartous

were undermaintained or were not in use because they were in disrepair. This means that approximately 40 percent of the capacity was unavailable for use at that time.

Capacity

The capacity of the entire pipeline system is approximately 13 million tons per year between Tal Addas and Tartous. The current flow estimate is about 9 million tons per year.

The nominal capacity of the storage facilities including the tanks that are currently under construction is approximately 1 million cubic meters. However, the practical capacity of the system in the fall of 1979 was only 625,000 cubic meters.

The loading rate of the sea lines and sea berths at Tartous is about 8,000 tons per hour. Mooring time at each berth is about six hours, and the two berths operate independently.

Evaluation

The operation of the system is not always efficient because the existing flows are only 60 percent of capacity and the periods of operation are controlled by supply and demand requirements as well as by the capacity of the support facilities.

Infrastructure maintenance is a particular problem because of the high sulfur content of Syrian crude oil, which shortens the life of the infrastructure facilities.

TRAFFIC

In 1979 traffic on the pipeline was as follows:

	Tons (000)	Distance	Ton Kms (000)
Tal Addas-Homs	2,000	560	1,120,000
Tal Addas-Tartous	7,000	660	4,620,000
Total	9,000		5,740,000

Without new discoveries in the present oil fields, this volume will probably drop in the future.

COSTS

Detailed financial and economic costs were developed for SCOTRACO for 1979 in order to calculate overall per-ton-kilometer

costs of operation. Table A-5.2 shows the financial costs and Table A-5.3 the economic costs. Wages and salaries have been assumed to be variable in the analysis, but in the short term, of course, at least a high proportion would be fixed. The actual breakdown of fixed and variable is in fact not too important in this case because tariffs and tariff setting is not involved.

The important aspect is really the actual cost of transportation in the pipeline, which works out to be about 1.63 piasters per ton-kilometer on total financial costs and about 1.35 piasters on economic costs. The financial cost compares favorably with pipelines in other parts of the world, being less than U.S. $0.05 per ton-kilometer. In Egypt, the pipeline system overall, including crude and white products, had an overall financial cost of U.S. $0.085 per ton-kilometer in 1975. It has been recently estimated that a new products pipeline in Syria (Homs-Aleppo) would have a total financial cost of U.S. $0.01 per ton-kilometer. It can be concluded, then, that SCOTRACO is being operated on a cost effective basis. Furthermore, greater throughput could improve this situation even more if the present labor costs (assumed to be variable in the analysis) remained stable with increased volume.

Table A-5.2

SYRIAN CRUDE OIL TRANSPORT COMPANY

FINANCIAL COSTS BY CATEGORY, 1979

(SP 000)

Variable Costs	Cost
Wages, Allowances, and Benefits	20,515.3
Fuel and Oil	15,800.0
Spare Parts	5,500.0
Maintenance[1]	750.0
Miscellaneous Services and Supplies	3,160.0
Total Variable	45,725.3
Fixed Costs	
Maintenance	2,250.0
Depreciation	40,000.0
Subsidies	2,040.0
Transport and Travel	800.0
Fees and Taxes	2,000.0
Other Fixed Costs	325.0
Total Fixed	47,615.0
Total Costs of Operation	93,340.0

Source: SCOTRACO reports.

[1] Assumed to be 25% variable, 75% fixed.

Table A-5.3

SYRIAN CRUDE OIL TRANSPORT COMPANY

ECONOMIC COSTS, 1979

(SP 000)

	Total	Variable	Fixed
Financial Cost	93,340	45,725	47,615
Deduct:			
Depreciation	40,000	-	40,000
Subsidies & Misc. Government Levies Paid	2,250	-	2,250
Taxes Paid	2,000	-	2,000
Total Deductions	44,250	-	44,250
Add:			
Adjustment on Value of Fuel and Oil[1] 15,800 x 2.8 - 15,800	28,440	28,440	-
Economic Costs	77,530	74,165	3,365

Source: Consultants' estimates.

[1] World price in January 1980 calculated to be 2.8 times domestic price for oil and fuel.

CHAPTER A-6

ECONOMIC ANALYSIS OF PIPELINES

Chapter A-6

ECONOMIC ANALYSIS OF PIPELINES

INTRODUCTION

For Phase I a number of possible petroleum product pipeline projects were discussed and preliminary conclusions reached with respect to priorities. The projects mentioned were as follows:

- Homs-Aleppo	183 kilometers
- Aleppo-Al Raqqa	190 kilometers
- Al Raqqa-Deir Ez Zor	130 kilometers
- Al Raqqa-Al Hassakeh	195 kilometers
- Adra-Damascus-Dera'a	100 kilometers

Another route has also been analyzed in Phase II - the alternative of linking Homs-Al Raqqa directly overland rather than via Aleppo. This route would have a total distance of 260 kilometers of new construction, or 70 kilometers more than Aleppo-Al Raqqa, but would result in savings in pipe cost on the Homs-Aleppo line.

Pipeline alternatives were studied in some detail for SADCOP in 1977 by Williams Brothers Engineering Company.[1] That study developed a regional forecast of petroleum product consumption and attempted to optimize a pipeline distribution system to serve the 1990 demand. Intermodal comparisons were also made. While the present study has drawn on this report for the technical aspects of pipeline construction and operation, considerable modification has taken place in the intermodal analysis, mainly through the use of actual Syrian transport costs. The next section on methodology explains the analysis in greater detail.

Methodology

The pipelines analysis is essentially an intermodal problem and has been carried out on a present value of total cost comparison basis. A 30-year accumulation of costs of the life of the pipeline has been undertaken with operating costs held constant after 2000. Unit costs for road and rail are those developed elsewhere in this report. A brief discussion of how each modal cost was used is in the following sections.

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[1] Products Distribution Network, Conceptual Design, Williams Brothers Engineering Company, 1977.

Rail

Average rail per ton-kilometer costs are assumed to be those which will occur when 1985 productivity improvements are achieved. However, the basic 1979 movement cost of SP .023/per ton-kilometer, used in Phase I, has been increased by 17 percent to reflect the large wage increases granted in February 1980 to rail workers. These raises were catch-up increases and therefore resulted in an understatement of 1979 rail costs. Thus the basic movement cost used in the calculations is SP .0269 per ton-kilometer. This cost assumes an empty return haul. Other non-movement costs are SP .03 per ton-kilometer for a total rail cost of SP .0569 per ton-kilometer. Equipment costs have been phased with the growth in product demand. Actual equipment requirements resulting from the analysis below are included in Volume III, Chapter A-8, and the recommended investment program is in Volume VII, Chapter 3.

Two different cases have been used with respect to train and tank car utilization. Case A assumes a 100,000-kilometer utilization for locomotives and tank cars, while Case B assumes the same 100,000-kilometer utilization for locomotives but tank car utilization at the assumed system average of 25,000 kilometers per year. Other rail assumptions are:

- Each car has a 58-ton capacity.
- Each train has 18 wagons.
- Cost of locomotives - SP 3 million.
- Cost of tank cars - SP 100,000.

Road

Road costs include a capital component in the running costs, so capital additions have not been calculated separately. This would conform to the actual situation if trucks were to be used as new equipment would be added regularly as the volumes increase each year. Hence, there is no need for a separate capital investment calculation. Average total road costs are calculated to be 26 piasters per ton-kilometer.

Pipeline

Pipeline costs have been derived mainly from the pipeline companies in Syria and the Williams Brothers report. Capital costs are based on current experience with pipeline construction in Syria and are derived from the Williams Brothers study. Operating costs have been derived from all three pipeline com-

panies in Syria but mainly from SADCOP and are based on current operating estimates for the new Homs-Adra pipeline. One major cost component had to be derived, however: the cost of pumping. SADCOP does not have clearly defined pumping costs because it does not pay for power directly. Thus, the power consumption costs have been derived from the Williams Brothers report for each route segment, adjusted for the forecast volumes used in this report. An average cost of 2.03 piasters per ton-kilometer for pumping, based on the above calculations, was developed. The pumping costs tend to rise with volume on a per-ton-kilometer basis, while other costs of operation fall. It is estimated that on the new Homs-Adra pipeline, costs other than pumping will fall from 1.42 piasters per ton-kilometer to about .5 piasters per ton-kilometer. Pumping costs, on the other hand, as calculated above, would rise from about .99 piasters per ton-kilometer to over 2.0 piasters, and ultimately as high as 3.0 piasters per ton-kilometer when the line is operating near maximum capacity. An overall long-term total average cost per ton-kilometer of 2.75 piasters has been used. This is the approximate cost of operation when operating at about 75 percent of capacity.

Traffic

A forecast of petroleum product consumption by Mohafaza is presented in Table A-6.1. Alternative forecasts which raise or lower the consumption volume will not change the basic conclusions reached in this analysis with respect to priorities, although a lower forecast could affect the timing of investment in facilities. A higher forecast would simply move future projects forward a few years. The analysis, however, is not designed to specify exact phasing but rather to indicate which projects are likely to be required in the time frame to 2000. Detailed feasibility and engineering studies will define the schedule of projects more precisely.

Table A-6.2 shows the total tonnages that would move over each route segment. Thus, the Homs-Hama segment includes all volumes that move beyond Hama to Idleb, Aleppo, Al Raqqa, etc., as well as the Hama tonnage. Table A-6.3 shows the ton-kilometers on each segment of the routes between 1979 and 2000 for each mode. The differences in ton-kilometers over the same routes reflect differences in distance between destinations by the individual modes.

RESULTS OF ANALYSIS

Homs-Aleppo

The Homs-Aleppo analysis is complicated by the possible alternative of direct routing to Al Raqqa from Homs rather than

Homs-Aleppo-Al Raqqa. Thus, this analysis, shown in detail in Tables A-6.9 and A-6.10, involves comparing road, rail, and pipeline movement over the route with two different tonnages: one which includes traffic to the northeast regions of Syria (Al Raqqa, Deir Ez Zor, and Al Hassakeh), and one which includes only Aleppo region traffic. The tonnages that would be dropped along the route to Hama and Idleb have not been included in the analysis. This would add about 10 percent to costs in both rail and pipeline cases but would not be significant enough to affect the overall conclusions in the analysis. Table A-6.4 summarizes the results of the present values of net costs of moving petroleum products from Homs to Aleppo. The conclusion to be drawn from the analysis is that if only the demand for petroleum products in Aleppo is considered, rail is the least-cost solution. As tonnages increase, however, the rail and pipeline alternatives become closer in total cost. For example, when Aleppo and all northeast tonnages are included, rail is 22 percent cheaper than pipeline, whereas it is 41 percent less expensive at the lower tonnage level. If the pipeline is delayed to 1990, the alternatives differ by 11 percent. This indicates that if the northeast tonnage is to move via Aleppo, the Homs-Aleppo pipeline should be planned to open about 2000 or shortly thereafter. A more careful analysis of the northeast tonnage routing follows in a later section.

Road transport has also been included in this case simply to demonstrate the high cost nature of this mode as compared to rail and pipeline. In the road case, which includes only Aleppo tonnage, costs are 2.6 times greater than rail and 1.5 times greater than pipeline. This clearly shows that road is inappropriate for long-distance haulage of petroleum products. Further comparisons with road in other cases have not been undertaken except where rail is not available as an alternative, i.e., Adra-Dera'a.

Finally, it should be noted that the results for rail are not sensitive to rather drastic changes in the utilization of the tank car fleet. Reducing utilization from 100,000 kilometers per year to the assumed system average in 1985 of 25,000 kilometers per year only increases the cost of the rail alternative by about 6 percent.

Aleppo-Al Raqqa

Table A-6.5 summarizes the rail and pipeline comparison on the Aleppo-Al Raqqa route. Details are shown in Tables A-6.11 and A-6.12. In all cases, rail is the least-cost alternative even under reduced utilization assumptions. Again, delaying the pipeline brings total costs of the two modes closer together. In this case, equality is not approached until well into the

Table A-6.1

PETROLEUM PRODUCTS FORECAST OF CONSUMPTION 1985-2000

(000 tons)

	Gasoline			Kerosine			Diesel		
	1979	1985	2000	1979	1985	2000	1979	1985	2000
Damascus City & Mohafaza	210.4	288.4	548.1	135.9	225.9	662.0	533.8	731.5	1,401.5
Dera'a	25.2	34.3	60.0	16.2	26.9	72.5	103.4	141.1	248.6
Quneitra	0.0	0.0	5.7	0.0	0.0	6.8	0.0	0.0	26.1
Al Suweida	5.0	7.0	12.3	3.3	5.5	14.1	23.0	31.8	56.4
Homs	43.3	61.4	115.7	28.0	48.1	139.7	254.5	360.5	684.5
Hama	37.8	54.1	99.6	24.4	42.5	120.3	162.3	232.5	431.0
Tartous	22.9	30.7	53.4	14.8	24.0	64.5	98.6	132.3	232.0
Lattakia	33.4	44.8	80.4	21.6	35.1	145.2	96.3	128.9	233.1
Idleb	17.8	23.9	41.6	11.5	18.7	50.4	135.2	180.5	317.6
Aleppo	97.3	132.5	245.3	62.8	103.7	296.4	512.5	697.6	1,302.0
Al Raqqa	19.5	26.3	46.7	12.6	20.5	56.5	105.5	141.8	254.7
Deir Ez Zor	12.8	17.0	30.2	8.3	13.3	36.5	91.6	122.1	218.1
Al Hassakeh	33.4	61.1	76.3	21.6	47.9	92.1	183.0	242.1	421.7
Total	558.8	781.5	1,415.3	361.0	612.1	1,757.0	2,299.7	3,142.7	5,827.3

Source: 1978 SADCOP 1985 and 2000 Consultants' forecasts.

Table A-6.2

PETROLEUM PRODUCTS TONNAGE BY ROUTE SEGMENT

(000 tons)

	Aleppo-Al Raqqa[1]			Homs-Al Raqqa Direct[1]			Other		
	1979	1985	2000	1979	1985	2000	1979	1985	2000
Homs-Hama	1,550	2,178	4,137	1,062	1,486	2,904			
Hama-Idleb Drop	1,325	1,849	2,486	837	1,157	2,2[illegible]3			
Idleb-Aleppo	1,161	1,626	3,076	673	[illegible]34	1,844			
Aleppo-Al Raqqa	488	692	1,233						
Al Raqqa-Al Hassakeh	238	351	590	238	351	590			
Al Raqqa-Deir Ez Zor	113	152	285	113	152	285			
Homs-Al Raqqa Direct				488	692	1,233			
Adra-South[2]							176	246	503
Homs-Adra							1,056	1,492	3,112
Homs-Lattakia							151	209	459

Source: 1979 SADCOP, 1985 and 2000 Consultants estimates based on Table A-5.1.

1 Routing.

2 Includes only tonnage moving south of Damascus.

Table A-6.3

TON-KILOMETER BY ROUTE SEGMENT BY MODE FOR PETROLEUM PRODUCTS

(in million ton-kilometers)

	Homs-Aleppo			Homs-Aleppo[1]		Aleppo-Al Raqqa	Al Raqqa-Deir Ez Zor		Al Raqqa-Al Hassakeh	
Year	Pipeline	Rail	Road	Pipeline	Rail	All Modes	Rail	Road	Pipeline	Rail
1979	123	134	130	212	232	93	14	16	38	63
1980	130	147	137	225	246	98	15	17	41	67
1981	137	150	145	238	160	104	16	17	43	72
1982	145	158	153	251	275	110	17	18	46	77
1983	153	167	161	265	291	117	18	19	49	82
1984	162	177	171	281	307	124	19	20	53	87
1985	171	187	180	297	325	131	20	21	56	93
1986	179	195	189	310	339	132	20	22	58	96
1987	187	204	197	324	354	142	21	23	60	100
1988	196	214	206	338	369	147	22	24	62	103
1989	205	224	216	353	385	153	23	25	64	107
1990	214	234	226	368	402	159	24	26	67	111
1991	224	245	237	384	420	165	25	27	69	114
1992	235	256	248	400	438	172	26	29	72	119
1993	246	268	259	418	467	179	27	30	74	123
1994	257	281	271	436	477	186	29	31	77	127
1995	269	294	284	455	497	193	30	32	79	132
1996	281	308	297	475	519	201	31	34	82	136
1997	294	322	311	495	542	209	32	35	85	141
1998	308	337	325	517	565	217	34	37	88	146
1999	322	352	340	539	590	225	35	38	91	151
2000	337	369	356	563	615	234	37	40	94	156

Source: Consultants' calculations.

[1] Includes Northeast traffic.

Table A-6.4

PETROLEUM PRODUCT TRANSPORT - INTERMODAL ANALYSIS
SUMMARY OF PRESENT VALUE TOTAL COSTS
HOMS-ALEPPO
(000 SP)

		1980-2005	1980-2010
Rail			
Case A	Homs-Aleppo Traffic only	72,680	76,873
Case B	Homs-Aleppo + Northeast Traffic	140,301	146,185
Case C	Case B w/Tank Car Utilization at 25,000 KMS/Yr.	148,351	154,633
Road		189,822	202038
Pipeline			
Case A	Homs-Aleppo Traffic only	122,724	124,480
Case B	Homs-Aleppo + Northeast Traffic	179,537	182,469
Case C	Case B w/opening delayed to 1991		164,164

Source: Tables A-6.9 and A-6.10

Table A-6.5

PETROLEUM PRODUCTS TRANSPORT - INTERMODAL ANALYSIS
SUMMARY OF PRESENT VALUE COSTS
ALEPPO-AL RAQQA
(000 SP)

Rail		1980-2005	1980-2010
Case A	Equipment Utilization at 100,000 Kms/Yr	69,698	72,222
Case B	Tank Car Utilization at 25,000 Kms/Yr	76,538	79,365
Pipeline	(20 year life)		
Case A	Open 1986	105,989	107,164
Case B	Open 1991		91,371
Case C	Open 1996		84,600

Source: Tables A-6.11, A-6.12, and A-6.13

1990s, and opening a pipeline to Al Raqqa would not appear to be justified until after 1995.

As already mentioned, another alternative for serving Al Raqqa has been given consideration. The direct route involves a shorter distance to Raqqa of about 113 kilometers but would involve an additional 70 kilometers of pipeline construction. On the other hand, adding capacity to the Homs-Aleppo line adds capital cost at the beginning of the period and higher operating costs later. Because implementation of this alternative would affect the decision on the Homs-Aleppo line, the best way to consider this possibility is to compare total modal costs in various combinations for serving total Aleppo and northeast demand. Table A-6.6 summarizes these alternatives. Table A-6.13 shows the detailed data for the direct route with two opening dates, 1985 and 1990. The differences between the alternatives are not great, but the results indicate that a direct Homs-Al Raqqa pipeline plus rail service to Aleppo is the least cost alternative. However, it is only 1 percent less than the all-rail alternative via Aleppo (Alternative 2) and 9 percent less than the pipe/rail combination (Alterative 5).

It should be cautioned that because these results are within the margin of error that could be expected in such calculations, they are inconclusive. Much more careful study of the pipe costs, pipeline construction costs on the direct route, and pumping costs on the two alternatives would be necessary before a firm decision could be made. One advantage of the direct route is that construction could be postponed and immediate capital costs saved on the Homs-Aleppo line. On the other hand, operational convenience of the longer route plus the possibility of serving other population centers with drop-offs in the Homs-Aleppo-Al Raqqa corridor may favor this route. In general, then, the possibility of the shorter route probably warrants more study and should be included in any feasibility study for a new pipeline to Aleppo.

Al Raqqa-Al Hassakeh

If a pipeline is built to Al Raqqa, a possible extension would be a line to Al Hassakeh. Significant distance savings are possible with such a line as the pipeline distance would be about 160 kilometers whereas the rail distance is 265 kilometers and the highway is 319 kilometers. The results, summarized in Table A-6.7, indicate that a pipeline, as compared to rail, is more expensive. Rail is cheaper by about 16 percent as compared to opening a pipeline in 1990. Details are shown in Table A-6.14 and A-6.15.

Table A-6.6

PETROLEUM PRODUCTS TRANSPORT
COST SUMMARY OF PRESENT VALUE FOR ALTERNATIVE ROUTES
ALEPPO-AL RAQQA
(000 SP)

Alternative 1		
All Pipe Homs-Aleppo to Al Raqqa		
	Open 1985	231,644
	Open 1990	248,764
Alternative 2		
All Rail Homs-Aleppo to Al Raqqa		218,407
Alternative 3		
Pipe	Homs-Al Raqqa Direct + Pipe to Aleppo	
	Open 1985	268,621
	Open 1990	264,181
Alternative 4		
Pipe	Homs-Al Raqqa Direct - Rail to Aleppo	
	Open 1985	221,014
	Open 1990	216,574
Alternative 5		
Pipe to Aleppo-Rail Aleppo- Al Raqqa		
	Open Pipeline 1985	254,691
	Open Pipeline 1990	236,386

Source: Table A-6.9 through A-6.13

Table A-6.7

PETROLEUM PRODUCTS TRANSPORT - INTERMODAL COST ANALYSIS
SUMMARY OF PRESENT VALUE TOTAL COSTS
AL RAQQA-AL HASSAKEH
(000 SP)

		1980-2005	1980-2010
Rail			
Case A	Equipment Utilized at 100,000 KMS/Yr	48,882	50,569
Case B	Tank Cars Utilized at System Average of 25,000 KMS/Yr	53,935	56,170
Pipeline			
Case A	Pipeline Operational 1985	64,804	
Case B	Pipeline Operational 1990		59,989
Case C	Pipeline Operational 1997		58,112

Source: Tables A-6.14 and A-6.15

Adra-Dera'a

One final possible project examined is an extension of a pipeline from Adra to a point south of Damascus to serve southern areas of Syria. The possible attraction of this project is that it could replace truck transport, which as demonstrated above, is a relatively costly mode for petroleum products. The results (Table A-6.8) show that trucks are marginally less expensive than pipelines over the period, but this is likely a result of the relatively low volumes to be moved. However, if the airport were served en route or a new distribution terminal located just south of Damascus were established, the line would be more attractive. Of course, if new rail services were established to the south, rail would doubtless be the most attractive mode for serving a southern distribution point.

Other Projects

The capacity of the Homs-Adra pipeline has recently been nearly tripled to 1.6 million tons. This capacity will be reached by about 1986 or 1987. This will mean that planning for future expansion will be required by this time. However, as the results of the analysis in this chapter indicate, a substantial level of tonnage is necessary before a new line is economically justified. Thus, it will be about 1994 to 1996 before new capacity will be justified, that is, when existing capacity is exceeded by 800,000 to 1,000,000 tons.

Sensitivity

There are three variables which would have a significant impact on the results if they were markedly different from the assumptions in the above analysis. These variables are capital costs of pipelines, operating costs of railways, and tonnage to be moved. Because the results are not definitive and, if anything, indicate rail in most instances, significant upward capital cost changes in pipelines would only reinforce this conclusion. Consequently, no detailed analysis was undertaken on the basis of increased capital except for the Homs-Al Raqqa route, where an increased capital cost case of 20 percent was calculated. Reduced capital costs are not considered probable so this was not included as an alternative.

Increased operating cost assumptions on the railway could change the balance of rail/pipeline indicated in the basic analysis. To test this, operational costs were assumed to be SP .07 per ton-kilometer, or 23 percent above the level assumed in the basic analysis. This sensitivity was tested on the Homs-Aleppo link. Finally, the impact of increased tonnage throughout the period was analyzed. A 6.7 percent growth rate

between 1985-2000 was assumed rather than the 4.3 percent used in the basic case, and the Homs-Aleppo rail and pipeline total costs were tested. Details are shown in Table A-6.16.

In summary, the sensitivity cases calculated are:

Case 1: Total cost supply Aleppo and Al Raqqa - pipeline Homs-Al Raqqa with +20 percent pipeline costs; rail supply to Aleppo.

Case 2: Homs-Aleppo rail with SP .07 per ton-km, rail operating costs.

Case 3: Homs-Aleppo rail and pipeline cases with increased traffic growth rate.

Case 1 sensitivity corresponds to Alternative 4 in Table A-6.6. The 20 percent increase in pipeline costs for Homs-Al Raqqa has the effect of increasing the total cost of serving Aleppo and the northeast to SP 231 million, increasing the total cost by 7 percent. This capital cost increase makes the closest alternative in the basic analysis (Alternative 2, all rail Homs-Aleppo-Al Raqqa) the least-cost solution.

The assumed increase in rail operating costs in Case 2 raises the present value of the rail alternative for serving Aleppo to SP 174 million. This compares to SP 180 million for the pipeline alternative. Hence, the higher rail costs would not justify a decision in favor of the pipeline to be constructed by 1985. Again, however, the comparison is marginal. However, the change in total costs of the rail alternative is over 20 percent, or nearly proportional to the assumed increases in per unit costs. The following summarizes the results.

Rail Unit Costs SP/ton-km	Rail Total Cost Homs-Aleppo + Northeast Tonnage (000 SP)	Pipeline Total Costs-Basic Analysis (000 SP)
.0569	140,301	179,537
.07	173,789	179,537

In Case 3, where a higher overall tonnage forecast is assumed, the pipeline and rail alternatives for all tonnage to Aleppo become much closer, assuming a 1985 opening for the pipeline. The results are compared below.

Table A-6.8

PETROLEUM PRODUCTS TRANSPORT - INTERMODAL ANALYSIS
ADRA-DERA'A
(000 SP)

Year	Pipeline			Road
	Capital	Operating	Total Cost	Total Cost
1980		5,913	5,913	5,913
1981	19,318	6,249	25,567	6,249
1982	19,318	6,610	25,918	6,610
1983	19,818	6,989	26,807	6,989
1984		977	977	7,389
1985		1,033	1,033	7,813
1986		1,084	1,084	8,194
1987		1,136	1,136	8,596
1988		1,191	1,191	9,008
1989		1,250	1,250	9,453
1990		1,313	1,313	9,928
1991		1,375	1,375	10,404
1992	961	1,442	2,403	10,912
1993		1,514	1,514	11,451
1994		1,585	1,585	11,990
1995		1,665	1,665	12,593
1996		1,745	1,745	13,227
1997		1,829	1,829	13,830
1998	2,581	1,916	4,497	14,496
1999		2,012	2,012	15,226
2000		2,110	2,110	15,955
Total Present Value	1980-2000		63,682	64,105
	1980-2005		64,053	69,429
	1980-2010		64,317	72,449

Source: Consultants' estimates.

Homs-Aleppo	Basic Tonnage Forecast (000 SP)	Increased Tonnage (000 SP)
Rail	140,301	163,997
Pipeline	179,537	176,411

This simply demonstrates that higher tonnage will advance the date when a pipeline becomes feasible as compared to rail.

Sensitivity analysis on the other routes studied would indicate similar results. Greater volumes and/or increased rail costs will advance the date when a pipeline becomes viable.

Summary and Recommendations

Three modes have been considered for the transport of oil products in the future: road, pipeline, and rail. Of the three, road has very limited competitive ability for long-distance transport and it was not considered on all of the possible route links.

The choice between rail and pipeline is a function of volumes available and capacity on the railroad. All rail calculations have assumed capital costs for rolling stock only and that right-of-way capacity is available. Pipeline calculations include all costs.

The conclusions reached in the analysis with respect to serving the north and northeast regions are that the least-cost solution, as long as rail right-of-way capacity is available to Aleppo, is to build a pipeline direct to Al Raqqa and to serve Aleppo by rail. However, the alternatives of all rail to Aleppo and Al Raqqa are only slightly more expensive and the differences are within the margin of error expected in such an analysis. When the railways become capacity restricted, pipelines will be the least cost solution, and it is expected that the Homs-Aleppo and Aleppo-Al Raqqa lines will not be approaching capacity until after 2000. Therefore, the northeast should not be served by pipelines until after 2000. Finally, a pipeline to supply areas south of Damascus is not immediately viable even compared to road transport.

Sensitivity tests indicate that higher tonnages than forecast will advance the date for pipeline building as will higher rail costs. On the other hand, higher pipeline construction costs and/or lower tonnages and constant rail costs will delay pipeline viability.

The following recommendations arise from the preceding analysis:

- A detailed engineering and economic feasibility study should be carried out for the northeast region encompassing the following alternatives:

1. Pipeline - Homs-Aleppo-Al Raqqa

2. Pipeline - Homs-Al Raqqa and Homs-Aleppo

3. Pipeline - Homs-Al Raqqa
   Rail - Homs-Aleppo

- A feasibility study should be undertaken for pipeline supply of petroleum products to Damascus Airport, a new distribution center in south Damascus, and a southern distribution point near Dera'a.

- Rail costs and capacities should be carefully monitored. Higher cost levels and capacity restrictions will have a significant impact on pipeline planning.

Subject to the results of these analyses, the Consultants have forecast the following product pipeline investments between 1985 and 2000:

- Homs-Adra, Cost: SP 109,000,000.
- Homs-Al Raqqa direct, Cost: SP 105,387,000.

Table A-6.9

PETROLEUM PRODUCTS TRANSPORT-HOMS-ALEPPO-RAIL

(000 S[illegible])

Year	CASE A Capital	CASE A Operation	CASE A Total	CASE B Capital	CASE B Operation	CASE B Total	CASE C Capital	CASE C Operation	CASE C Total
1979									
1980		4,152	4,152		10,040	10,040	1,400	10,040	11,440
1981	5,100	4,600	9,700	5,100	10,848	15,948	4,400	10,848	15,248
1982		5,086	5,086		11,701	11,701	1,500	11,701	13,201
1983		5,592	5,592		12,605	12,605	1,500	12,605	14,105
1984		6,128	6,128		13,560	13,560	1,600	13,560	15,160
1985		6,694	6,694	5,100	14,570	19,670	4,600	14,570	19,170
1986		7,187	7,187		15,374	15,374	1,700	15,374	17,074
1987	5,100	7,702	12,802		16,217	16,217	1,800	16,212	18,012
1988		8,243	8,243		17,087	17,087	1,900	17,087	18,987
1989		8,807	8,807	5,100	18,000	23,100	5,100	18,000	23,100
1990		9,399	9,399		18,953	18,953	1,400	18,953	20,353
1991		10,017	10,017		19,946	19,946	1,400	19,343	20,743
1992	5,100	10,665	15,765	5,100	20,984	26,084	4,400	20,984	25,384
1993		11,342	11,342		22,066	22,066	1,500	22,066	23,566
1994		12,051	12,051		23,195	23,195	1,500	23,195	24,695
1995		12,791	12,791	5,100	24,373	29,473	4,600	24,373	28,973
1996	5,100	13,568	18,668		25,603	25,603	1,700	25,603	27,303
1997		14,380	14,380		26,886	26,886	1,800	26,886	28,686
1998		15,229	15,229	5,100	28,224	33,324	4,900	28,224	33,124
1999		16,118	16,118		29,620	29,620	2,000	29,620	31,620
2000	5,100	17,049	22,149		31,078	31,079	2,100	31,078	33,178
Total Present Value 1980-2000			65,290			129,931			137,281
1980-2005			72,680			140,301			148,351
1980-2010			76,873			146,185			154,633

Source: Consultants' estimates.

Table A-6.10

PETROLEUM PRODUCTS TRANSPORT-HOMS-ALEPPO-ROAD AND PIPELINE

(000 SP)

Year	Road Total	Pipeline Case A Capital	Pipeline Case A Operation	Pipeline Case A Total	Pipeline Case B Capital	Pipeline Case B Operation	Pipeline Case B Total	Pipeline Case C Capital	Pipeline Case C Operation	Pipeline Case C Total
1979										
1980	7,656		4,152	4,152		10,040	10,040		10,040	10,040
1981	9,358	32,100	4,606	36,706	35,670	10,848	46,518	5,100	10,848	15,948
1982	11,776	27,000	5,086	32,086	30,570	11,701	42,271		11,701	11,701
1983	14,009	27,000	5,592	32,592	30,570	12,605	43,175		12,605	12,605
1984	16,373	27,515	6,128	33,643	36,087	13,560	49,647	5,100	13,560	18,660
1985	18,866		4,699	4,699		8,182	8,182		14,570	14,570
1986	21,039		4,917	4,917		8,538	8,538	5,100	15,374	20,474
1987	23,312		5,145	5,145		8,909	8,909	30,570	16,212	46,782
1988	25,696		5,384	5,384		9,296	9,296	30,570	17,087	47,657
1989	28,185		5,634	5,634		9,699	9,699	35,670	18,000	53,670
1990	30,794		5,896	5,896		10,120	10,120	36,087	18,953	55,040
1991	33,519		6,169	6,169		10,560	10,560		10,560	10,560
1992	36,374		6,455	6,455		11,019	11,019		11,019	11,019
1993	39,360		6,755	6,755		11,497	11,497		11,497	11,497
1994	42,286		7,068	7,068		11,996	11,996		11,996	11,996
1995	45,753		7,396	7,396		12,517	12,517		12,517	12,517
1996	49,175		7,739	7,739		13,061	13,061		13,061	13,061
1997	52,758		8,098	8,098	11,670	13,629	25,299	11,670	13,629	25,299
1998	56,501		8,474	8,474		14,220	14,220		14,220	14,220
1999	60,421		8,867	8,867		14,838	14,838		14,838	14,838
2000	64,525		9,278	9,278		15,482	15,482		15,482	15,482
Total Present Value										
1980-2000	168,292			119,628			174,372			156,067
1980-2005	189,822			122,724			179,537			161,233
1980-2010	202,038			124,480			182,469			164,164

Source: Consultants' estimates.

Table A-6.11

PETROLEUM PRODUCTS TRANSPORT-ALEPPO-AL RAQQA-RAIL

(000 SP)

Year	Tank Cars-100,000 KM/YR			Tank Cars-25,000 KM/YR		
	Capital	Operation	Total	Capital	Operation	Total
1979						
1980		5,594	5,594	1,000	5,594	6,594
1981	5,100	5,929	11,029	4,000	5,929	9,929
1982		6,284	6,284	1,100	6,284	7,384
1983		6,661	6,661	1,100	6,661	7,761
1984		7,058	7,058	1,200	7,058	8,258
1985		7,482	7,482	1,300	7,482	8,782
1986		7,775	7,775	1,300	7,775	9,075
1987		8,081	8,081	1,400	8,081	9,481
1988		8,398	8,398	1,400	8,398	9,798
1989		8,728	8,728	1,000	8,728	9,728
1990	5,100	9,069	14,169	4,000	9,069	13,069
1991		9,426	9,426	1,100	9,426	10,526
1992		9,796	9,796	1,100	9,796	10,896
1993		10,180	10,180	1,200	10,180	11,380
1994		10,580	10,580	1,200	10,580	11,780
1995		11,426	11,426	1,300	11,426	12,726
1997		11,874	11,874	1,400	11,874	13,276
1998	5,100	12,341	17,441	4,400	12,341	16,741
1999		12,824	12,824	1,500	12,824	14,324
2000		13,328	13,328	1,600	13,328	14,928
Total Present Value 1980-2000			65,251			71,558
1980-2005			69,698			76,539
1980-2010			72,222			79,365

Source: Consultants' estimates.

Table A-6.12

PETROLEUM PRODUCTS TRANSPORT-ALEPPO-AL RAOQA PIPELINE

(000 SP)

Year	Opening 1986			Opening 1991			Opening 1996		
	Capital	Operation	Total	Capital	Operation	Total	Capital	Operation	Total
1979									
1980		5,594	5,594		5,594	5,594		5,594	5,594
1981	15,200	5,929	21,129	5,100	5,929	11,029	5,100	5,929	11,029
1982	20,463	6,284	26,747		6,284	6,284		6,284	6,284
1983	20,463	6,661	27,124		6,661	6,661		6,661	6,661
1984	20,463	7,058	27,521		7,058	7,058		7,058	7,058
1985	20,463	7,482	27,945	5,100	7,482	12,582		7,482	7,482
1986		3,619	3,619	5,000	7,775	12,775		7,775	7,775
1987		3,762	3,762	20,463	8,081	28,544		8,081	8,081
1988		3,909	3,909	25,563	8,398	33,961		8,398	8,398
1989		4,061	4,061	20,463	8,728	29,191		8,728	8,728
1990		4,222	4,222	21,850	9,069	30,919	10,200	9,069	19,269
1991	1,387	4,388	5,775		4,388	4,388	5,000	9,426	14,426
1992		4,560	4,560		4,560	4,560	25,563	9,796	35,359
1993		4,739	4,739		4,739	4,739	20,463	10,180	30,643
1994		4,925	4,925		4,925	4,925	20,463	10,580	31,043
1995		5,118	5,118		5,118	5,118	24,603	10,995	35,598
1996		5,319	5,319		5,319	5,319		5,319	5,319
1997	2,753	5,528	8,281	2,753	5,528	8,281		5,528	5,528
1998		5,745	5,745		5,745	5,745		5,745	5,745
1999		5,970	5,970		5,970	5,970		5,970	5,970
2000		6,204	6,204		6,204	6,204		6,204	6,204
Total Present Value 1980-2000			103,919			89,301			81,355
1980-2005			105,989			91,371			83,425
1980-2010			107,164			92,545			84,600

Source: Consultants' estimates.

Table A-6.13

PETROLEUM PRODUCTS TRANSPORT-HOMS-AL RAQQA DIRECT-PIPELINE

(000 SP)

Year	Opening 1985			Opening 1990		
	Capital	Operation	Total	Capital	Operation	Total
1979						
1980		10,982	10,982		10,982	10,982
1981	26,000	11,639	37,639		11,639	11,639
1982	26,000	12,337	38,337		12,337	12,337
1983	26,000	13,076	39,076	5,100	13,076	18,176
1984	26,000	13,857	39,857		13,857	13,857
1985		4,949	4,949		14,689	14,689
1986		5,142	5,142	5,100	15,264	20,364
1987		5,345	5,345	26,000	15,865	41,865
1988		5,554	5,554	26,000	16,487	42,487
1989		5,772	5,772	26,000	17,134	43,134
1990		5,998	5,998	27,387	17,804	45,191
1991	1,387	6,234	7,621		6,234	6,234
1992		6,479	6,479		6,478	6,478
1992		6,732	6,732		6,732	6,732
1994		6,997	6,997		6,997	6,997
1995		7,272	7,272		7,272	7,272
1996		7,557	7,557		7,557	7,557
1997	2,753	7,854	10,607	2,753	7,854	10,607
1998		8,162	8,162		8,162	8,162
1999		8,481	8,481		8,481	8,481
2000		8,815	8,815		8,815	8,815
Total Present Value 1980-2000			139,531			135,091
1980-2005			142,472			138,032
1980-2010			144,141			139,701

Source: Consultants' estimates.

Table A-6.14

PETROLEUM PRODUCTS TRANSPORT-AL RAQQA-AL HASSAKEH-RAIL

(000 SP)

	Tank Cars-100,000 KM/YR			Tank Cars-25,000 KM/YR		
Year	Capital	Operation	Total	Capital	Operation	Total
1979						
1980		3,827	3,827		3,923	3,923
1981	5,100	4,083	9,183	3,000	4,216	7,216
1982		4,358	4,358	300	4,531	4,831
1983		4,649	4,649	300	4,869	5,169
1984		4,959	4,959	300	5,233	5,533
1985		5,293	5,293	300	5,625	5,925
1986		5,480	5,480	400	5,879	6,279
1987		5,673	5,673	400	6,144	6,544
1988		5,872	5,872	400	6,421	6,821
1989		6,078	6,078	400	6,710	7,110
1990		6,294	6,294	400	7,013	7,413
1991		6,515	6,515	500	7,329	7,829
1992		6,745	6,745	500	7,660	8,160
1993		6,983	6,983	500	8,005	8,505
1994	5,100	7,229	12,329	3,000	8,366	11,366
1995		7,483	7,483	500	8,744	9,244
1996		7,747	7,747	600	9,138	9,738
1997		8,020	8,020	900	9,550	10,450
1998		8,302	8,302	900	9,981	10,881
1999		8,595	8,595	900	10,431	11,331
2000		8,898	8,898	900	10,907	11,807
Total Present Value 1980-2000			45,913			49,996
1980-2005			48,882			53,935
1980-2010			50,567			56,170

Source: Consultants' estimates.

Table A-6.15

PETROLEUM PRODUCTS TRANSPORT - AL RAQQA-AL HASSAKEH PIPELINE

(000 SP)

Year	CASE A			CASE B			CASE C		
	Capital	Operation	Total	Capital	Operation	Total	Capital	Operation	Total
1979									
1980		3,827	3,827		3,923	3,923		3,923	3,923
1981	5,100	4,083	9,183	5,100	4,216	9,316	5,100	4,216	9,316
1982	13,600	4,358	17,958		4,531	4,531		4,531	4,531
1983	13,600	4,649	18,249		4,869	4,869		4,869	4,869
1984	13,600	4,959	18,559		5,233	5,233		5,233	5,233
1985	14,237	5,293	19,530		5,625	5,625		5,625	5,625
1986		1,717	1,717		5,879	5,879		5,879	5,879
1987		1,796	1,796	13,600	6,144	19,744	5,100	6,144	11,244
1988	640	1,899	2,539	13,600	6,421	20,021		6,421	6,421
1989		1,965	1,965	13,600	6,710	20,310		6,710	6,710
1990		2,055	2,055	14,877	7,013	21,890		7,013	7,013
1991		2,150	2,150		2,150	2,150		7,329	7,329
1992		2,249	2,249		2,249	2,249		7,660	7,660
1993	2,001	2,352	4,353	2,001	2,352	4,353		8,005	8,005
1994		2,461	2,461		2,461	2,461	13,600	8,366	21,966
1995		2,574	2,574		2,574	2,574	13,600	8,144	21,744
1996		2,692	2,692		2,692	2,692	13,600	9,138	22,738
1997		2,816	2,816		2,816	2,816	16,878	2,816	19,694
1998		2,945	2,945		2,945	2,945		2,945	2,945
1999		3,081	3,081		3,081	3,081		3,081	3,081
2000		3,222	3,222		3,222	3,222		3,222	3,222
Total Present Value	1980-2000		63,729			58,299			56,427
	1980-2005		64,804			59,374			57,502
	1980-2010		65,414			59,984			58,112

Source: Consultants' estimates.

Table A-6.16

PETROLEUM PRODUCTS TRANSPORT-SENSITIVITY CASES

(000 SP)

Year	Case 1 Capital	Case 1 Operation	Case 1 Total	Case 2 Capital	Case 2 Operation	Case 2 Total
1979						
1980		10,982	10,982		11,610	11,610
1981	31,200	11,639	42,839	5,100	12,604	17,704
1982	31,200	12,337	43,537		13,653	13,653
1983	31,200	13,076	44,276		14,765	14,765
1984	31,200	13,856	45,056		15,940	15,940
1985		4,949	4,949	5,100	17,183	22,283
1986		5,142	5,142		18,172	18,172
1987		5,345	5,345		19,203	19,203
1988		5,554	5,554		20,279	20,279
1989		5,772	5,772	5,100	21,402	26,502
1990		5,998	5,998		22,575	22,575
1991	1,387	6,234	7,621		23,798	23,796
1992		6,479	6,479	5,100	25,073	30,173
1993		6,732	6,732		26,404	26,404
1994		6,997	6,997		27,793	27,793
1995		7,272	7,272		29,243	29,243
1996		7,557	7,557	5,100	30,576	35,856
1997	2,753	7,854	10,607		32,334	32,334
1998		8,162	8,162		33,980	33,980
1999		8,481	8,481		35,698	35,698
2000		8,815	8,815	5,100	37,491	42,591
Total Present Value						
1980-2000			153,633			151,515
1980-2005			156,574			165,726
1980-2010			158,243			173,789

Source: Consultants' estimates.

Table A-6.16 (Continued)

PETROLEUM PRODUCTS TRANSPORT-SENSITIVITY CASES

(000 SP)

	CASE 3					
	Pipeline			Rail		
Year	Capital	Operation	Total	Capital	Operation	Total
1979						
1980		9,437	9,437		9,437	9,437
1981	30,570	10,245	40,815	5,100	10,245	15,345
1982	30,570	11,098	41,668		11,098	11,098
1983	30,570	12,002	42,572		12,002	12,002
1984	36,087	12,957	49,044	5,100	12,957	18,057
1985		13,967	13,967		13,967	13,967
1986		8,538	8,538	5,100	15,106	20,206
1987		8,909	8,090		16,325	16,325
1988		9,296	9,296	5,100	17,631	22,731
1989		9,699	9,699		18,335	18,335
1990		10,120	10,120	5,100	20,528	25,628
1991		10,560	10,560	5,100	22,130	27,230
1992		11,019	11,019	5,100	23,846	28,946
1993		11,497	11,497	5,100	25,682	30,782
1994		11,996	11,996	5,100	27,646	32,746
1995		12,517	12,517	5,100	29,747	34,847
1996	11,670	13,061	24,731	10,200	31,995	42,195
1997		13,629	13,629	5,100	34,399	39,499
1998		14,220	14,220	5,100	36,971	42,071
1999		14,838	14,838	10,200	39,721	49,921
2000		15,482	15,482	5,100	42,663	47,763
Total Present Value						
1980-2000			171,245			148,060
1980-2005			176,411			163,997
1980-2010			179,342			173,040

Source: Consultants' estimates.

III

PART III

CONSTRUCTION AND STORAGE INDUSTRIES

A. CONSTRUCTION
B. STORAGE

A. CONSTRUCTION INDUSTRY

A. CONSTRUCTION INDUSTRY

A-1 SUMMARY OF FINDINGS

The heavy civil works construction industry in Syria is dominated by state-owned firms. These firms generally specialize in a given construction sphere and are invited in turn to negotiate for major projects. Private companies also exist in Syria but tend to be smaller because they are excluded from participating in the large projects as prime contractors. Finally, foreign firms are also active in heavy construction and are eligible to bid on foreign-funded projects. Foreign firms and private domestic firms are also used for highly specialized projects where state-owned firms lack the experience necessary to complete the work.

State-owned companies appear to have unrestricted access to the equipment required for civil works construction projects, but they have difficulty keeping qualified personnel. There are adequate material and equipment resources available to complete the 5th Five-Year Plan program providing that existing equipment is properly maintained and worn-out equipment continues to be replaced in a timely manner as is currently the practice.

Existing firms will not be required to expand as they did in the 4th Plan period because the 5th Plan will emphasize betterment and maintenance of existing works and de-emphasize the rapid expansion of the infrastructure as experienced since the time the public sector firms were first established. This should ease if not eliminate the staffing bottleneck noted above.

This chapter provides an overview of the heavy construction industry in Syria. The overview includes a discussion of the types of firms operating in Syria, their staffing configuration, and issues related to their acquisition and use of construction equipment.

Further discussions and analyses of the construction industry's capabilities and performance are provided in the appropriate modal volumes. For example, railroad construction methods are discussed in Volume III, Section A-3.6, and highway construction methods are discussed in Volume IV, Section 3.2.

A-2 GENERAL

It is to be noted that the Consultants experienced great difficulty in obtaining data on the Syrian construction

industry. To accurately assess current and future capability, information on equipment, personnel, and types of contracts engaged in are necessary. Such information was not always made available, however, and when it was, it was occasionally incorrect. The Consultants' study is necessarily limited by these difficult circumstances.

When the Consultants undertook to obtain the information required for an effective analysis of the construction industry, the Ministry of Communications requested that Consultant personnel not approach the public sector companies unless accompanied by a counterpart designated by the Ministry and that all results of any questionnaire be submitted to the designated counterpart prior to their use by the Consultants.

A cross section of the industry made up of nine firms (four state owned, four privately owned, and one foreign) was selected for interviews and presentation of a prepared questionnaire. The designated counterpart assisted in the selection, the setting up of interviews, and the distribution of the questionnaires. The questionnaire is shown in Figure A-2.1.

The firms selected for interview were:

State Owned

General Road Construction Company (RODCO)
Syrian Road Company
Mount Kassioun Company
General Construction Company

Privately Owned

Leon Yakobian Company
Bozan Yakobian Company
Khaldon Atase and Bros. Company
Fo'ud Takla Company

Foreign Owned

Bresciano S.P.A.

Two questionnaires were completed and returned, one each from a privately owned local firm and one from a foreign firm. A series of meetings was held with state-owned firms, but data from only one firm were obtained on an informal basis. This effort was complicated by the fact that the designated counterpart was withdrawn during the process, and a substitute counterpart was never provided. In the final stages of Phase II, some additional data were furnished to the Consultants by RODCO.

Figure A-2.1

CONSTRUCTION INDUSTRY QUESTIONNAIRE

1. Name of Firm

2. Location of Firm

3. Ownership of Firm

   (a) Private
   (b) Government
   (c) Foreign

4. Speciality

   (a) Engineering
   (b) Construction
      (1) Roads
      (2) Structures
      (3) Other

5. Major Projects During 5 Years

   (a) Roads

      (1) _____
      (2) _____
      (3) _____
      (4) _____
      (5) _____

   (b) Structures (other)

      (1) _____
      (2) _____
      (3) _____
      (4) _____
      (5) _____

6. Disposition of Projects

   (a) Complete
   (b) Underway
   (c) Other

7. Gross Annual Turnover

8. Total Value of Projects Underway

Figure A-2.1 (Continued)

CONSTRUCTION INDUSTRY QUESTIONNAIRE

9. Number and Names of Prospective Projects

(a) _____
(b) _____
(c) _____
(d) _____
(e) _____

10. Number of Permanent Employees (Categories)

(a) Administrative personnel
(b) Technical personnel
(c) Construction or supervisory personnel

(1) Foremen
(2) Supervisors
(3) Equipment operators
(4) Skilled laborers
(5) Unskilled laborers
(6) Others

11. Balance Sheets Profit and Loss Statements for Two Years Budget 1980

12. Organizational Chart for the Company

13. Extent to which Principal Authority is Delegated Within the Organization for:

(a) Contract and bid preparation
(b) Procurement
(c) Construction operations

14. Project Management Techniques such as C.P.M. Pert, etc.

15. Three Most Important Factors Currently Adversely Affecting the Performance of the Company

(a) _____
(b) _____
(c) _____

Figure A-2.1 (Continued)

CONSTRUCTION INDUSTRY QUESTIONNAIRE

EQUIPMENT

Type of Equipment	Quantity	Year	Operating Hours	Condition		
				Good	Average	Poor
1. Bulldozer (type) D-6						
2. Bulldozer (type) D-7						
3. Bulldozer (Type) D-8						
4. Bulldozer (Type) D-9						
5. Other						
6. Motorgrader (Type) G12						
7. Motorgrader (Type) G14						
8. Loader (Type) 955						
9. Loader (Type) 977						
10. Other						
11. Backhoe						
12. Compactor Pneumatic						
13. Compactor Vibratory						
14. Compactor Impact						
15. Truck Pickup						

Figure A-2.1 (Continued)

CONSTRUCTION INDUSTRY QUESTIONNAIRE

EQUIPMENT

Type of Equipment	Quantity	Year	Operating Hours	Condition		
				Good	Average	Poor
16. Truck Dump						
17. Truck Flatbed						
18. Truck Distributer						
19. Compressor Portable						
20. Compressor Truck Mounted						
21. Steel Wheel Roller						
22. Crusher Plant Stationary						
23. Crusher Plant Mobile						
24. Asphalt Hot Mix Plant						
25. Concrete Mixer Portable						
26. Concrete Mixer Transit Mix						
27. Concrete Mixer Vibrators						
28. Compactor Hand						

As a result, this report on the potential of construction firms in Syria is based heavily on observations of work and of equipment usage in the field and on interviews with field personnel. However, the statistics in this report are based on the statistics supplied.

A-3 CONSTRUCTION COMPANIES, CATEGORIES, AND AWARDS

The Syrian construction industry consists of

- state owned companies,
- privately owned companies, and
- foreign-owned companies.

State Owned Companies

Created by Legislative Decree No. 137-7-1975, the state-owned companies constitute the most powerful and largest domestic work force. The major state-owned companies are:

Syrian Building Company
General Construction Company
General Water Project Company
Syrian Irrigation Structures Company
Construction Works Company
General Road Construction Company (RODCO)
Syrian Road Company
General Concrete Company
General Industrial Construction Company
Al Rasafa Building and Construction Company
The Mount Kassioun Company
Military Construction Establishment
Military Housing Establishment

These state-owned companies are semi-autonomous bodies with independent managers who, under the oversight of the Higher Board for Construction Companies, are responsible only to the Prime Minister.

The state-owned companies are restricted by Government regulations as to salary structure, and although their salaries are not necessarily in the same range as other Government agencies, they are nevertheless not competitive with private industry.

Privately-Owned Companies

The private companies are not entirely excluded from projects that fall within the five-year plans, but their opportunity for projects is limited.

Privately owned companies do not have the same salary restrictions as public firms; therefore, key personnel, professional, technical, and non-technical, may be paid salaries commensurate with their abilities. Bonuses are paid as an incentive to increase production.

Delegation of authority is more widely practiced in the privately owned companies because of continuity. Encouraged by reasonable salaries, personnel remain with the company, making it possible for them to become proficient in their field.

Normal international practice is for construction and improvement works to be open to all qualified bidders and for contract awards to be made to the lowest bidder. This is not the procedure in Syria.

All non-foreign-funded projects included in the five-year plan estimated to exceed SP 1,000,000 are directly allocated to a state-owned company by the Higher Board for Public Sector Companies. All military companies are included.

Immediately upon the award of the contract, the state-owned company must prepare a construction budget and submit it to the Higher Board. Usually, after a period of consultation, a final price is determined. This final price is not binding on the state-owned company, since excessive costs due to escalation of prices, duties on construction equipment, taxes, or penalty clauses are absorbed by the Government.

All projects included in a five-year plan estimated to be less than SP 1,000,000 are offered for bids to the state-owned companies. If none of these companies is interested, privately owned companies may bid.

On specialized Government projects, the state-owned companies may subcontract portions of the work to private companies or foreign firms.

Non-government projects are bid by private companies.

Government projects financed by foreign agencies normally may be bid upon by state-owned, foreign, or private companies, although this may vary depending on the terms of the foreign financing.

A-4 OPERATIONS

A primary reason for the establishment of state-owned construction companies was the idea that state-owned firms, with their wide resources, could bid actively against foreign-owned firms

on projects involving foreign funds. Recently, several state-owned firms have expanded and become involved in road construction on the secondary and tertiary road networks. This extension and dilution of personnel and equipment may greatly reduce their ability to perform current work on the primary network. This work has historically been done by private firms. Expansion of state-owned firms into this sector will reduce desirable competition and may, in the longer term, result in over expansion.

When the 4th and 5th Five-Year Plans are completed, there will be a greatly reduced need for the state-owned construction firms. When presently committed highway projects are completed there will be only two or three new projects required up to the year 2000. The highly specialized construction firms will necessarily revert to a position where they will be reduced to the jobs, although very important, of road betterment and maintenance. The expertise of construction is of a completely different nature from that of maintenance. The transition for a state-owned firm will be more difficult than for a privately or foreign-owned firm because of the greater flexibility associated with competitive companies.

The state-owned firms, at the end of the 5th Five-Year Plan, must be in a position to compete with foreign-owned and privately owned firms on the basis of performance if both construction and maintenance operations are to improve in quality.

In order to reach such a goal, it is necessary that public construction companies bid competitively, without special favor, against each other and private and foreign firms. Subsequently, if a state-owned company is awarded a bid on its own merits, the work should be accomplished in compliance with specifications and should be subject to inspection and approval prior to acceptance.

A-5 PERSONNEL AND EQUIPMENT

Personnel

A publication prepared by one of the major state-owned road construction firms indicates that manpower utilization for three years has been as shown in Table A-5.1.

The trend by 1977 was to correctly decrease the percent of administrative staff and increase production staff. The decrease in the percent of service staff from 22 percent in 1976 to 18 percent in 1977, however, is not encouraging and is difficult to explain, since increased use and procurement of equipment should automatically increase the service staff.

Table A-5.1

MANPOWER UTILIZATION

Number of Personnel

Year	Total	Administrative	Service	Production
1975	310	110	40	160
1976	820	150	180	490
1977	1700	200	300	1200

Percent of Total

Year	Total	Administrative	Service	Production
1975	100 %	35 %	13 %	52 %
1976	100 %	18 %	22 %	60 %
1977	100 %	12 %	18 %	70 %
Average	100 %	22 %	18 %	60 %

Despite the special advantages of the state-owned companies in areas such as salaries, they are unwieldly, and as with most Government agencies, there is a great deal of bureaucracy, duplication, and wasted effort. Patronage has resulted in unqualified personnel often being placed in critical positions. Government salary restrictions are enforced and are often a detriment. Top echelon professional personnel are not induced to use their initiative with the promises of salary raises or bonuses. Middle and lower echelon professional staff are generally a captive group consisting of young engineering graduates who are ordered by law to serve five years with government agencies. Immediately upon completing their service, this potentially top-performance group leaves the employment of the state-owned companies to seek employment with private-owned firms or else to work overseas.

The top technical staffs are competent, but there is a lack of initiative on their part. This group is in reality the backbone of any construction company.

During the study, it was noted that:

- Bureaucratic inefficiency could be reduced if administrative personnel were chosen on the basis of ability.

- Many of the field supervisory personnel are really learning their profession on the job, and the past practice of limited inspection and approval has not been conducive to training personnel.

- Time work studies should be carried out, with trained construction personnel as instructors, to insure efficient use of equipment.

A summary of personnel composition by type of personnel and type of firm drawn from the limited available data is shown in Table A-5.2. The imbalance in engineering and construction personnel between public and private companies is apparent.

Equipment

The high cost of importing construction equipment and spare parts has, out of necessity, forced the private contractors to choose utilitarian equipment and to use such equipment to its best advantage. The percent of private equipment deadlined is comparatively low compared to that of a state-owned company. However, because of import restrictions and high duties, deadlined equipment is often cannabilized to keep the other equipment operational.

Table A-5.2

TYPE AND COMPOSITION OF PERSONNEL

Type of Firm	Type of Personnel (Percent of Total)		
	Administrative	Engineering	Construction (including Supervisors)
State owned	15 %	30 %	55 %
Private	9 %	12 %	89 %
Foreign	10 %	12 %	88 %

Table A-5.3

TYPE AND COMPOSITION OF EQUIPMENT

Type of Firm	Type of Equipment (Percent of Total)				
	Earthwork	Hauling	Compacting	Concrete	Asphalt
State owned	7 %	79 %	11 %	2 %	1 %
Private	40 %	17 %	17 %	17 %	9 %
Foreign	29 %	51 %	11 %	2 %	7 %

Sources: Consultants' interviews and data supplied by public and private firms.

For the public companies, however, the quantitiy of construction equipment apparently does not pose a serious problem, although equipment quality does. Relatively abundant equipment, and little difficulty in replacing it, promotes a definite lack of preventive maintenance. When a piece of equipment is in poor condition, it is usually taken to the workshops for repairs. First and second echelon operator maintenance apparently does not exist. This condition occurs because the equipment is not assigned to specific operators and because there is a large turnover of personnel.

Moreover, if one particular state-owned company is in need of extra equipment, the cost of renting it from one of the other companies is minimal. Standardization of equipment is desirable but not always possible since stipulations accompanying foreign loans often include restrictions on the source of construction equipment. Maintaining spare parts and personnel to keep standardized equipment running is efficient and less costly. Consideration should be given to a method of standardizing state-owned company equipment wherever possible.

Available statistics regarding equipment distribution in state owned, private domestic, and foreign firms are summarized in Table A-5.3. Most notable is the relatively high percentage of hauling equipment in the inventories of the state-owned companies, although the percentage is distorted somewhat by a large number of pickup trucks.

Since 1975 construction equipment having a total value of SP 336 million has been imported under the USAID Commodity Import Program alone. Of this total, SP 45 million was for RODCO, SP 29 million was for Mount Kassioun, and SP 13 million was for the Syrian Road Company.

The Mount Kassioun Company cited the equipment listed in Table A-5.4 as being available in early 1980. The listing is not complete by type or quantity, since it represents availability for one major project.

As noted earlier, late in Phase II, RODCO gave the Consultants a complete equipment inventory. This inventory appears in Table A-5.5

Additionally, both the Mount Kassioun Company and RODCO are procuring equipment for the construction of a new 104 kilometer, four-lane divided highway from Damascus to Dera'a. The quantities and types of equipment to be purchased for each firm are shown in Table A-5.6.

Manufacturers' recommendations for equipment maintenance and use imply minimum life expectancies of ten years. The above

Table A-5.4

PARTIAL INVENTORY - MOUNT KASSIOUN COMPANY

Description and Type		Quantity	Condition
Bulldozer	0-9	1	New
	0-8	7	New
Front & Loader	988	1	New
	966	2	New
Scraper	$30M^3$	2	Good
Vibratory Rollers		5	Good
Dump Truck	$25M^3$	5	Good
Rock Crusher	180 T/h	1	Good
Asphalt Plant	150 T/h	1	Good
Small Trucks	$6-8M^3$	15	Good

Source: Kassioun Company.

Table A-5.5

EQUIPMENT INVENTORY - RODCO

Description and Type		Quantity	Condition		
			Good	Average	Poor
Bulldozer	D-6	3	1	1	1
	D-7	30	21	6	3
	D-8	19	13	4	2
	D-9	37	26	7	4
Graders	G12	20	14	4	2
	G14	23	16	5	2
	(Small)	4	2	1	1
Wheeled Loaders	920	5	2	1	1
	930	8	5	2	1
	950	49	34	10	5
	966	13	9	3	1
	988	8	6	2	-
Track Loaders	955	12	8	2	2
	977	9	6	2	1
	983	3	1	1	1
Bobcat Loaders		13	9	2	2
Scrapers	Cat. D631	10	7	2	1
	Cat. D637	6	4	1	1
	F/Allis	1	-	-	1
Rollers Vibrating		89	62	18	9
Rollers Rubber Tired		13	9	2	2
Rollers Steel Drum		44	31	9	4
Rollers Small		18	13	3	2
Excavators	Fiat 105CB	2	1	1	-
	70CR	1	-	1	-
	Cat. 235	3	1	1	1
	Poclain	3	1	1	1

Table A-5.5 (Continued)

EQUIPMENT INVENTORY - RODCO

Description and Type		Quantity	Condition		
			Good	Average	Poor
Dump Trucks	(6-wheel)	93	65	17	11
	(Other)	192	134	38	20
Tankers		53	37	11	5
Trucks		13	9	2	2
Truck Tractors		42	29	8	5
Engine Pulled Tankers		46	32	9	5
Semi Trailers		47	33	9	5
Cranes		25	17	5	3
Crushers, Central		21	15	4	2
Crushers, Mobile		1	-	1	1
Tractors, Track		11	8	2	1
Tractors, Wheeled		32	22	6	1
Mixers, Stationary		4	3	1	-
Mixers, Mobile		64	40	12	12
Dumpers, Large		49	34	9	6
Dumpers, Small		47	33	9	5
Concrete Finishers		3	2	1	-
Bitumen Boilers		39	27	7	5
Asphalt Plants, Stationary		14	10	2	2
Asphalt Plants, Mobile		15	10	2	3
Air Compressors		71	-	-	-
Mobile Workshops		22	15	4	3
Pickup Trucks		108	75	22	11
Light Vehicles		187	130	37	20

Source: RODCO.

Table A-5.6

AID-PROCURED EQUIPMENT, DAMASCUS-DERA'A HIGHWAY

Description and Type		Approximate Quantity	
		Mount Kassioun	RODCO
Dozer	410 H.P.	10	10
	300 H.P.	4	4
	200 H.P.	-	3
Wheel Loader	4.5 M^3	8	5
	2.3 M^3	5	2
	1.6 M^3	23	5
	1.2 M^3	5	5
Track Loader	2.9 M^3	-	2
Motor Grader	180 H.P.	4	5
	250 H.P.	4	3
Wheel Tractor Scrapers	16 M^3	-	5
Excavator	1.0 M^3	-	2
Compactor with Dozer	300 H.P.	-	4
Asphalt Paver		2	3
Asphalt Plant	150 T/h	1	1
	250 T/h	-	1
Rock Crusher	200 T/h	2	2
Crane Self-Propelled Rough Terrain	35 T	1	2
Crane Self-Propelled Rough Terrain	15 T	-	2
Tractor and Lowboy Trailer	50-60 T	1	2
Off-Highway Rear Dumper	35 T	8	15

Table A-5.6 (Continued)

AID-PROCURED EQUIPMENT, DAMASCUS-DERA'A HIGHWAY

Description and Type		Approximate Quantity	
		Mount Kassioun	RODCO
Dump Trucks	10-12 Yd^3	70	20
Tank Truck Water to 15,000 Lit		10	25
Tank Trailer Water 30,000 Lit with Trailer		-	5
Tank Truck Fuel 14,000 Lit		4	4
Truck Mobile Workshop		1	3
Truck, Mobile Lubrication		3	3
Truck, Mobile Concrete Mixer	6 M^3	6	8
Bottom Dump Tractor and Trailer	28 Yd^3	-	40
Truck Drill 2 1/2 - 4 1/2 inch		5	-
Asphalt Distributor Truck	2,000 Gal.	2	2
Autograder		1	1
Belt Loader		-	4
Automobile 4 Dr. Sedan		14	10
Truck	3/4 T 4x2	5	-
Trucks, Crewcab	3/4 T 4x4	5	-

Table A-5.6 (Continued)

AID-PROCURED EQUIPMENT, DAMASCUA-DERA'A HIGHWAY

Description and Type		Approximate Quantity	
		Mount Kassioun	RODCO
Generators	100 KVA	-	-
	250 KVA	2	-
	500 KVA	-	2
	1,000 KVA	-	1
Testing Laboratory Equipment		1	1
Roller		12	17
Water Well Drill		1	-
Gradall		1	1

Source: U. S. Agency for International Development.

equipment listings are, therefore, significant when added to existing inventories. Since equipment demands for new construction will decrease as the 5th Five-Year Plan is completed, as future construction programs revert to roads of a lower class and fewer kilometers, and as maintenance operations increase, equipment projections imply strongly that demands on such equipment will not exceed its availability.

The General Company for Railway Construction was established with responsibility for the construction of all new Chemin de Fer (CFS) lines. The General Company is responsible to the Director General of CFS, although in most respects it acts as an independent body. Its headquarters are in Aleppo and, by decree, its capital limit is SP 100 million.

The organization table of the General Company for Railway Construction is shown in Volume III, Plate A-2.3, with a key to the position numbers in Volume III, Table A-2.5. The southern projects, which at present constitute the bulk of the work, are administered from an office in Homs. For financial control purposes and monitoring of the physical progress of projects, the CFS Director of Planning and Statistics acts as intermediary between the construction company and the Ministry of Transport and other Government departments. The budget of the company is set by CFS after Government approval. The company acts purely as the construction arm of the railway, although with a greater freedom of action, particularly in the field of salary structure and recruitment, than the railway itself.

Currently, construction is in progress on three lines, including Homs to Damascus, Mehine to Charkie, and Homs II to Vodehi (realignment).

Construction as well as communications is well organized. The latter covers the concrete-tie manufacturing plants, track assembly yards, ballast crushing plants, and site construction. Construction schedules are realistic and monthly construction goals are being completed on time.

A comprehensive description and discussion of the railroad construction program and capability is contained in Volume III of the Final Phase I Report.

A-6 THE OVERALL CONSTRUCTION SECTOR

In terms of constant 1975 prices, the construction sector of the Gross Domestic Product in Syria grew at an average annual rate of 9.6 percent from 1963 to 1979. The largest proportion of that growth took place between 1970 and 1979, when the sector as a whole more than doubled. The Consultants have fore-

cast reduced growth rates for the future, with an expected annual growth rate of 7.6 percent from 1979 to 1985 and 6.4 percent from 1986 to 2000. Given the economy's ability (and by implication the construction industry's ability) to maintain high growth rates in the past, the projected lower growth rates in the future should be within the industry's capability, given reasonable expansion.

This is particularly true in the transport sector, where major new projects in roads, rail, and ports are expected to reduce drastically after the completion of the projects already committed, that is, by the end of the 5th Five-Year Plan.

A-7 CONCLUSIONS

Predictions regarding equipment availability, and collateral conclusions regarding current and future capabilities of contractors, are difficult to make because of the previously cited lack of information. The Consultants have concluded, however, that the construction industry, in general, will be sufficiently equipped to accomplish the 1981-1985 highway and ports programs as currently envisioned. Additionally, adequate equipment should be available for highway maintenance. Similarly, the General Company for Railway Construction has the capacity to complete the presently committed projects and to do additional work when they are completed. However, if additional projects, such as the Deir Ez Zor-Albu Kamal line are undertaken concurrently with current work, they should be contracted out, rather than increasing the company's capacity in the face of a virtual cessation of new railway construction after 1985.

However, it should be noted that the conclusion that the current construction industry, including both public and private, has the potential and can adequately complete the 5th Five-Year Plan as scheduled, assumes that:

- Equipment is properly maintained, spare parts supplies are sufficient, and units are maintained properly.

- There are no major additions to the 5th Five-Year Plan.

- Funds and personnel remain available as now planned.

The Consultants believe that competitive bidding would help create a more equitable distribution of projects between the public and private companies and that this would greatly assist in developing a healthier and more viable construction industry.

B. STORAGE

B. STORAGE

B-1 INTRODUCTION

During Phase I of this study, the Consultants' work on the storage sector focused principally on carrying out an overall review of the major storage and warehousing facilities in the country. At that time, the Consultants' completed an inventory of storage capacities at major ports where sufficient past data were available. The results of that inventory as well as a significant number of pressing operational problems at the ports and at other major agencies requiring immediate attention were reported in Volume V, Parts B and C and Volume VI, Part B of the Final Phase I Report. Efforts to complete an inventory of the rest of the storage sector were seriously hampered by a lack of basic data vital to the Consultants' work. Consequently, a major supplemental data gathering and research effort had to be mounted by the Consultants covering most of the public companies and agencies connected with agricultural commodities and trade. These included:

- General Organization of Grains Trading and Manufacturing.
- General Flour Mills Company.
- General Company for Exploitation of Silos, Feed, and Seed Plants.
- General Cotton Marketing and Ginning Organization.
- Agricultural Cooperative Bank.
- General Organization of Cigarettes and Tobacco.
- Foreign Trade Organization for Vehicle and Equipment (Aftomachine).
- Internal Trade Organization of Metals and Construction Materials (Intermetal).
- General Fodder Organization.
- General Consumption Organization.
- General Fruits and Vegetables Company.
- General Cold Storage Company.

The storage facilities of these companies and agencies, together with those of the major ports, represent the bulk of the storage capacity of the country.[1]

Data were collected from each of the above agencies on a Mohafaza-by-Mohafaza basis. To obtain the data, the Consultants conducted a series of interviews with planning officers of these agencies at their head offices. Storage capacity data by Mohafaza were obtained and estimates of utilization were made. Extensive field trips to the major Mohafazat were also made, and discussions with local officers of these agencies were held to verify data obtained from their head offices.

B-2 INVENTORY OF STORAGE CAPACITY

On the basis of the above data, the Consultants completed an inventory of present storage facilities of these agencies and organizations. For each agency and organization, the inventory covered the following aspects of storage facilities:

- the type of storage,
- present storage capacity,
- commodities usually handled,
- percentage of utilization during peak and low periods,
- inventory turnover rates,
- addition to present capacity effected by carryover projects from the 4th Five-Year Plan,
- preliminary plans for further expansion of storage capacity in the 5th Five-Year Plan, and
- estimates of unit cost of construction.

A Mohafaza-by-Mohafaza tabulation of current storage capacity and planned expansions in the 5th Five-Year Plan period is presented in Tables B-1 to B-12.

An overall summary showing the above-mentioned aspects of the storage facilities by agency and organization is given in Table B-13.

The availability of data varied quite substantially from one agency to another. Much of the data are derived from informa-

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[1]Findings on storage facilities at ports and airports and concerning petroleum products are discussed in the modal chapters.

tion supplied orally during the interviews. Information on planned future operations and investment consists in large part of judgmental responses of persons responsible for planning in each agency. The Consultants believe, however, that the data collected provide a useful overview of the storage sector, of its existing capacities, and of the type and location of additional capacity requirements.

B-3 SUMMARY OF FINDINGS AND RECOMMENDATIONS

Of the twelve major agencies whose storage facilities were covered in the inventory, four reported capacity utilization rates ranging from 10 percent to 40 percent during low periods and from 45 percent to 80 percent during peak periods. Four agencies reported 100 percent use of capacity during peak periods and 65 percent to 85 percent use in the low periods; only one agency reported serious shortage of capacity during peak periods (150 percent rate of utilization, using open space). These five agencies reported plans to expand their capacities. The estimated additional capacities and approximate unit costs are reported in Table B-13. Two of the agencies have facilities currently under construction; one agency did not have any available records on capacity utilization.

Lack of systematically recorded data of recent years, and particularly the unavailability of records on turnover, makes it impractical to attempt to estimate the dynamic storage capacity (i.e., capacity over time based on rates of stock turnover) versus static capacity (physical capacity at one point in time). This report, inevitably, deals with the latter.

The results of the inventory show that there is very substantial potential capacity in the storage sector which can be realized through improvement in management and operational practices. Specific recommendations for short-term improvements for selected agencies with major storage facilities were discussed and presented in Volume VI, Part III-B of the Final Phase I Report. These recommendations are equally applicable to virtually all other storage facilities. Our findings have reconfirmed the need for immediate implementation of these recommendations.

In the storage facilities where full use or a shortage of capacity was reported, plans for expansion are either underway or are being formulated. These facilities are identified by agency in Table B-13.

When current expansion at major ports is completed and the operational improvements recommended by the Consultants are implemented, Syria will have adequate storage capacity at these

ports to meet the forecast import, export, and transit storage requirements up to the year 2000.

The Consultants' findings do not indicate the need for additional storage facilities beyond what is under construction, committed, or planned as expansions in the rest of the storage sector. In most of the public companies, the doubling of effective capacity can be achieved by improving operational efficiencies which, together with current and planned expansion of capacities, should provide adequate sectorwide storage capacity to meet forecast commodity volume up to the year 1990.

However, to achieve better sectorwide planning and utilization of storage facilities, all public companies with major storage facilities should be directed to set up or improve their record-keeping systems to ensure the availability of systematically collected data on throughput and turnover rates, which are vital for storage factor assessment, analysis of throughput productivity, and forecasts of capacity requirements. Such systems are very important to any attempt to make long-term forecasts of the storage capacity required in relation to the forecast growth trends of the rest of the transport sector. As has already been pointed out, the bulk of the data collected by the Consultants from the 12 public companies covered in the inventory (i.e., data on capacity, its use, and the rates of turnovers) were oral and judgmental responses. No recorded data from the past years were available. Nevertheless, the data presented in this chapter are useful benchmarks on which efforts to build a better data base for future planning can be based.

In the short run, Government efforts should be concentrated on enforcing the implementation of measures to ensure fuller and more efficient use of existing storage facilities.

Table 3 - 1

GENERAL ORGANIZATION OF GRAINS TRADING AND MANUFACTURING

STORAGE CAPACITY

Mohafaza	1980			1985			Preliminary estimates in 5th FYP		
	M^2	M^3	Ton	M^2	M^3	Ton	M^2	M^3	Ton
Damascus	4,000	20,000	8,000	4,000	20,000	8,000	-	-	-
Dera'a	5,000	25,000	10,000	5,000	25,000	10,000	-	-	-
Al Suweida	200	1,000	400	200	1,000	400	1,250	6,250	2,500
Homs	54,000	270,000	108,000	54,000	270,000	108,000	-	-	-
Hama	37,500	187,500	75,000	37,500	187,500	75,000	-	-	-
Tartous	50	250	100	50	250	100	7,500	37,500	15,000
Lattakia	17,000	85,000	34,000	17,000	85,000	34,000	2,500	12,500	5,000
Idleb	2,000	10,000	4,000	2,000	10,000	4,000	3,750	18,750	7,500
Aleppo	100,000	500,000	200,000	100,000	500,000	200,000	-	-	-
Al Hassakeh	65,000	325,000	130,000	65,000	325,000	130,000	20,000	100,000	40,000
Al Raqqa	11,000	55,000	22,000	11,000	55,000	22,000	-	-	-
Deir Ez Zor	750	3,750	1,500	750	3,750	1,500	2,500	12,500	5,000
Total	296,500	1,482,500	593,000	296,500	1,482,500	593,000	37,500	187,500	75,000

Source: General Organization of Grains Trading and Manufacturing, original data in tons.

Table B-2

GENERAL FLOUR MILLS COMPANY

STORAGE CAPACITY

Mohafaza	1980			1985		
	M^2	M^3	Ton	M^2	M^3	Ton
Damascus	12,250	61,250	24,500	12,250	61,250	24,500
Dera'a	1,650	8,250	3,300	1,650	8,250	3,300
Al Suweida	340	1,700	680	340	1,700	680
Homs	6,900	34,500	13,800	6,900	34,500	13,800
Hama	3,000	15,000	6,000	3,000	15,000	6,000
Tartous	500	2,500	1,000	500	2,500	1,000
Lattakia	3,250	16,250	6,500	3,250	16,250	6,500
Idleb	3,000	15,000	6,000	3,000	15,000	6,000
Aleppo	10,550	52,750	21,100	10,550	52,750	21,100
Al Hassakeh	1,500	7,500	3,000	1,500	7,500	3,000
Al Raqqa	500	2,500	1,000	500	2,500	1,000
Deir Ez Zor	500	2,500	1,000	500	2,500	1,000
Total	43,940	219,700	87,880	43,940	219,700	87,880

Source: General Organization of Grains Trading and Manufacturing.

Table B-3

GENERAL COMPANY FOR EXPLOITATION OF SILOS, FEED, AND SEED PLANTS

STORAGE CAPACITY

Mohafaza	1980		1985		Preliminary estimates of 5th FYP
	M^3	Ton	M^3	Ton	Ton
Damascus	125,000	100,000	125,000	100,000	125,000	100,000
Dera'a	25,000	20,000	25,000	20,000	-	30,000
Al Suweida	-	-	-	-	-	-
Homs	62,500	50,000	62,500	50,000	-	50,000
Hama	87,500	70,000	87,500	70,000	-	50,000
Tartous	-	-	125,000	100,000	-	-
Lattakia	-	-	-	-	-	-
Idleb	25,000	20,000	25,000	20,000	-	30,000
Aleppo	125,000	100,000	125,000	100,000	62,500	50,000
Al Hassakeh	300,000	240,000	300,000	240,000	-	-
Al Raqqa	62,500	50,000	62,500	50,000	-	50,000
Deir Ez Zor	25,000	20,000	25,000	20,000	-	30,000
Total	837,500	670,000	962,500	770,000	962,500	390,000

Source: General Company of Silos, Feed, and Seed Plants. Original data in tons and cubic meters.

Table B-4

GENERAL COTTON MARKETING AND GINNING ORGANIZATION

STORAGE CAPACITY

Mohafaza	Tonnage 1980	Tonnage 1985
Damascus		
Dera'a		
Al Suweida		
Homs	1,000	1,000
Hama	6,000	6,000
Tartous		
Lattakia		
Idleb	1,000	1,000
Aleppo	15,000	15,000
Al Hassakeh	2,000	2,000
Al Raqqa		
Deir Ez Zor	6,000	6,000
Total	31,000	31,000

Source: General Cotton Marketing and Ginning Organization.

Table B-5

AGRICULTURAL COOPERATIVE BANK

STORAGE CAPACITY

Mohafaza	1980			1985		
	M^2	M^3	Ton	M^2	M^3	Ton
Damascus	6,572	31,546	12,618	6,572	31,546	12,618
Dera'a	2,327	11,169	4,468	2,327	11,169	4,468
Al Suweida	337	1,618	647	337	1,618	647
Homs	4,781	22,949	9,180	4,781	22,949	9,180
Hama	11,218	53,846	21,538	11,218	53,846	21,538
Tartous	4,064	19,507	7,803	4,064	19,507	7,803
Lattakia	10,739	51,547	20,619	10,739	51,547	20,619
Idleb	7,422	35,626	14,250	7,422	35,626	14,250
Aleppo	28,177	135,250	54,100	28,177	135,250	54,100
Al Hassakeh	5,501	26,405	10,562	9,501	45,605	18,242
Al Raqqa	8,406	40,349	16,140	8,406	40,349	16,140
Deir Ez Zor	9,764	46,867	18,747	10,747	51,667	20,667
Total	99,308	476,679	190,672	104,291	500,679	200,272

Source: Agricultural Cooperative Bank.

Table B-5

GENERAL ORGANIZATION OF CIGARETTES AND TOBACCO

STORAGE CAPACITY

Mohafaza	1980		1982		Preliminary estimates in 5th FYP	
	M^2	Ton	M^2	Ton	M^2	Ton
Damascus	3,150	700	3,150	700	-	-
Dera'a	-	-	-	-	-	-
Al Suweida	-	-	-	-	-	-
Homs	-	-	-	-	-	-
Hama	1,600	350	1,600	350	-	-
Tartous	4,400	500	4,400	500	-	-
Lattakia	98,000	19,000	98,000	19,000	30,000	6,000
Idleb	-	-	-	-	-	-
Aleppo	23,000	6,000	23,000	6,000	-	-
Al Hassakeh	-	-	-	-	-	-
Al Raqqa	-		-	-	-	-
Deir ez zor	-		-	-	-	-
Total	130,150	26,550	130,150	26,550	30,000	6,000

Source: General Organization of Cigarettes and Tobacco. Original data in tons and square meters.

Table B-7

FOREIGN TRADE ORGANIZATION FOR VEHICLES AND EQUIPMENT (AFTOMACHINE)

STORAGE CAPACITY

Mohafaza	1980		
	M^2	M^3	Ton
Damascus	25,560	76,680	15,335
Dera'a	-	-	-
Al Suweida	-	-	-
Homs	11,240	33,720	6,745
Hama	8,675	26,025	5,205
Tartous	15,000	45,000	9,000
Lattakia	13,350	40,050	8,010
Idleb	-	-	-
Aleppo	26,580	79,740	15,950
Al Hassakeh	-	-	-
Al Raqqa	-	-	-
Deir Ez Zor	2,016	6,048	1,210
Total	102,421	307,263	61,455

Source: Foreign Trade Organization for Vehicles and Equipment. Orignial data in tons, m^2, and m^3

Table B-7 (continued)

FOREIGN TRADE ORGANIZATION FOR VEHICLES AND EQUIPMENT (AFTOMACHINE)

STORAGE CAPACITY

Mohafaza	1985		
	M^2	M^3	Ton
Damascus	35,560	106,680	21,335
Dera'a	-	-	-
Homs	13,240	39,720	7,945
Hama	8,675	26,025	5,205
Tartous	21,000	63,000	12,600
Lattakia	13,350	40,050	8,010
Idleb	-	-	-
Aleppo	30,580	91,740	18,350
Al Hassakeh	-	-	-
Al Raqqa	-	-	-
Deir Ez Zor	4,016	12,048	2,410
Total	126,421	379,263	75,855

Table B-8

INTERNAL TRADE ORGANIZATION OF METALS AND CONSTRUCTION MATERIALS (INTERMETAL)

STORAGE CAPACITY

Mohafaza	1980			1985		
	M^2	M^3	Ton	M^2	M^3	Ton
Damascus	23,775	118,875	25,986	23,775	118,875	25,986
Dera'a	5,800	29,000	14,264	5,800	29,000	14,264
Al Suweida	4,070	20,350	18,184	4,070	20,350	18,184
Homs	9,049	45,245	7,180	9,049	45,245	7,180
Hama	12,880	64,400	46,540	12,880	64,400	46,540
Tartous	6,505	32,525	20,594	6,505	32,525	20,594
Lattakia	7,550	37,750	6,646	7,550	37,750	6,646
Idleb	4,260	21,300	6,348	4,260	21,300	6,348
Aleppo	23,000	115,000	25,060	23,000	115,000	25,060
Al Hassakeh	400	2,000	810	400	2,000	810
Al Raqqa	5,350	26,750	5,240	5,350	26,750	5,240
Deir Ez Zor	8,200	41,000	12,544	8,200	41,000	12,544
Total	110,839	554,195	189,396	110,839	554,195	189,396

Source: Internal Trade Organization of Metals and Construction Materials (Intermetal).

Notes: Orignial data were collected in the form of m^2 warehouse area and tonnage plus m^3 volume for timber. To obtain total m^3 volume, the m^2 area was cubed assuming a 5 meter warehouse height to obtain the total tons; the timber volume data in m^3 were converted in tons by using an average equivalent factor of 1 m^3 = 720 kg. The results were then added to the tonnage given.

Table B-8 (Continued)

INTERNAL TRADE ORGANIZATION OF METALS AND CONSTRUCTION MATERIALS (INTERMETAL)

OPEN SPACE STORAGE CAPACITY

Mohafaza	1980		1985	
	M^2	Ton	M^2	Ton
Damascus	187,075	2,554,096	187,075	2,554,096
Dera'a	22,250	39,400	22,250	39,400
Al Suweida	14,000	283,180	14,000	283,180
Homs	140,562	109,490	140,562	109,490
Hama	33,900	43,000	33,900	43,000
Tartous	8,850	34,950	8,850	34,950
Lattakia	10,650	26,500	10,650	26,500
Idleb	2,650	1,300	2,650	1,300
Aleppo	150,000	2,518,720	150,000	2,518,720
Al Hassakeh	79,500	78,472	79,500	78,472
Al Raqqa	10,288	9,500	10,288	9,500
Deir Ez Zor	5,500	8,000	5,500	8,000
Total	665,225	5,706,608	665,225	5,706,608

Source: Intermetal

Note: Original data were obtained in the form of m^2 open space storage area, tonnage capacity for all commodities except timber, for which m^3 volume was given. Timber volume was converted into tonnage using the equivalent factor of 1 m^3 = 720 kg. The resulting tons were added to the tonnage capacity of all other commodities handled.

Table B-9

GENERAL FODDER ORGANIZATION

STORAGE CAPACITY

Mohafaza	1980			1985		
	M^2	M^3	Ton	M^2	M^3	Ton
Damascus	15,664	78,322	31,329	23,164	115,822	46,329
Dera'a	3,378	16,890	6,756	3,378	16,890	6,756
Al Suweida	2,095	10,475	4,190	2,095	10,475	4,190
Homs	16,434	82,170	32,868	16,434	82,170	32,868
Hama	10,885	54,425	21,770	15,885	79,425	31,770
Tartous	4,661	23,305	9,322	4,661	23,305	9,322
Lattakia	3,438	17,190	6,876	3,438	17,190	6,876
Idleb	8,251	41,255	16,502	8,251	41,255	16,502
Aleppo	8,511	42,557	17,023	12,011	60,057	24,023
Al Hassakeh	7,198	35,990	14,396	8,198	40,990	16,396
Al Raqqa	4,685	23,425	9,370	4,685	23,425	9,370
Deir Ez Zor	6,737	33,687	13,475	6,737	33,687	13,475
Total	91,937	459,691	183,877	108,937	544,691	217,877

Source: General Fodder Organization, annual data in tons.

Table B-10

GENERAL CONSUMPTION ORGANIZATION

STORAGE CAPACITY

Mohafaza	1980 M^2	1980 M^3	1980 Ton	1985 M^2	1985 M^3	1985 Ton
Damascus	35,465	528,860	211,544	45,965	685,437	274,175
Dera'a	6,612	39,207	15,683	6,612	39,207	15,683
Al Suweida	5,350	20,019	8,008	9,850	33,115	13,246
Homs	19,454	126,000	50,400	22,959	148,668	59,467
Hama	14,510	84,752	33,901	16,510	96,434	38,574
Tartous	6,698	42,595	17,038	10,698	68,032	27,213
Lattakia	16,450	119,702	47,881	19,950	145,170	58,068
Idleb	8,815	58,484	23,394	12,815	85,022	34,009
Aleppo	33,033	242,386	96,954	37,033	271,737	108,695
Al Hassakeh	6,798	27,154	10,862	20,798	83,076	33,230
Al Raqqa	6,058	44,156	17,662	8,858	64,565	25,826
Deir Ez Zor	8,067	64,945	25,978	8,067	64,945	25,978
Total	174,315	1,398,260	559,304	227,115	1.785,408	714,163

Source: General Consumption Organization.

Note: Original data was obtained in m^2 area and m^3 volume. To estimate tonnage capacity, m^3 volume was converted to tons using the formula ($1\ M^3 \times \frac{2}{5} = 1$ ton).

Table B-10 (Continued)

GENERAL CONSUMPTION ORGANIZATION

STORAGE CAPACITY

Mohafaza	Preliminary Estimates in 5th FYP		
	M^2	M^3	Ton
Damascus	8,000	38,400	15,360
Dera'a	2,500	12,000	4,800
Al Suweida	4,000	19,200	7,680
Homs	7,500	36,000	14,400
Hama	8,500	40,800	16,320
Tartous	4,000	19,200	7,680
Lattakia	2,000	9,600	3,840
Idleb	2,000	9,600	3,840
Aleppo	1,000	4,800	1,920
Al Hassakeh	-	-	-
Al Raqqa	-	-	-
Deir Ez Zor	-	-	-
Total	39,500	189,600	75,840

Table B-11

GENERAL FRUITS AND VEGETABLES COMPANY

STORAGE CAPACITY

Mohafaza	Warehouse 1981 - 1985			Cold Storage 1981-1985			Warehouses Preliminary estimates in 5th FYP			Banana Store Preliminary estimates in 5th FYP	
	M^2	M^3	Ton	M^2	M^3	Ton	M^2	M^3	Ton	M^2	Ton
Damascus	1,000	5,000	2,000	100	500	200	6,000	30,000	12,000	750	25
Dera'a	-	-	-	-	-	-	1,000	5,000	2,000	-	-
Al Suweida	-	-	-	-	-	-	1,000	5,000	2,000	-	-
Homs	1,000	5,000	2,000	100	500	200	3,000	15,000	6,000	750	25
Hama	1,000	5,000	2,000	100	500	200	3,000	15,000	6,000	-	-
Tartous	-	-	-	-	-	-	1,000	5,000	2,000	750	25
Lattakia	1,000	5,000	2,000	100	500	200	1,000	5,000	2,000	750	25
Idleb	-	-	-	-	-	-	1,000	5,000	2,000	-	-
Aleppo	1,000	5,000	2,000	100	500	200	1,000	5,000	2,000	-	-
Al Hassakeh	-	-	-	-	-	-	1,000	5,000	2,000	750	25
Al Raqqa	-	-	-	-	-	-	1,000	5,000	2,000	-	-
Deir Ez Zor	-	-	-	-	-	-	1,000	5,000	2,000	750	25
Total	5,000	25,000	10,000	500	2,500	1,000	21,000	105,000	42,000	4,500	150

Source: General Fruits and Vegetables Company.

Note: Original data were collected in m^2 area. To obtain m^3 volume, a 5 m warehouse height was assumed. To estimate tonnage capacity, m^3 volume was converted to tons using the formula 1 ton = 2.5 m^3

Table B-12

GENERAL COLD STORAGE COMPANY

STORAGE CAPACITY

Mohafaza	1980			1985		
	M^2	M^3	Ton	M^2	M^3	Ton
Damascus	2,556	10,000	2,200	5,882	23,000	7,300
Dera'a	1,602	5,000	1,800	1,602	5,000	1,800
Al Suweida	1,602	5,000	1,800	1,602	5,000	1,800
Homs	2,556	10,000	2,200	2,556	10,000	2,200
Hama	1,278	5,000	1,100	2,556	10,000	3,100
Tartous	2,556	10,000	2,200	2,556	10,000	2,200
Lattakia	1,602	5,000	1,800	1,602	5,000	1,800
Idleb	1,602	5,000	1,800	1,602	5,000	1,800
Aleppo	5,112	20,000	4,400	5,112	20,000	4,400
Al Hassakeh	1,602	5,000	1,800	1,602	5,000	1,800
Al Raqqa	1,602	5,000	1,800	1,602	5,000	1,800
Deir Ez Zor	1,278	5,000	1,100	1,278	5,000	1,100
Total	24,948	90,000	24,000	29,552	108,000	31,100

Source: General Cold Storage Company.

Table B-13

SUMMARY OF FINDINGS ON NATION-WIDE
STORAGE CAPACITY AND USAGE OF MAJOR PUBLIC COMPANIES
(capacity figures in 000)

Organization	Type of Storage	Type of Commodity	Current Capacity In M^3	Percent used High	Percent used Low	Capacity In 1985 M^3	Planned Expansion In 5th FYP M^3	Estimate Construction Cost/M^2	Average Annual Stock Turn-over Rate
1. GOGTAM	Warehouse	A,B	1,482	150	75		187	SP 630/M^2	?
2. GFMC	Cold Storage	M	219	100	65		None	SP 630/M^2	NA
3. GESFP	Silo	A,D	837	65	40	962	962	NA	2
4. GCMGO	Warehouse	A	31	100	30	31	NA	NA	NA
5. ACB	"	B	190	100	75	500		900/M^2	4.6
6. GOCAT	"	A	650	100	60	650	150	NA	2
7. AFTOMACHINE	"	B,D	307	100	85	379	None	NA	NA
8. INTERMETAL	"	D	554	60	40	554	None	1000/M^2	NA
9. GFO	"	A,B,D	459	50	20	554	750	800/M^2	NA
10. GCO	"	A,B,D	1,398	NA	NA	1,785	189	1200/M^2	3.4
11. GFVC	"	A	25	NA	NA	2	105	NA	NA
	Cold Storage	A	2.5	NA	NA		37	NA	NA
12. GCSC	"	A	90	45	10	108	None	1500/M^2	2

Source: Consultants' survey.

Notes: Commodity Types: Agricultural = A Not Applicable = NA
Manufacturing = B Others = D