BIBLIOGRAPHIC DATA SHEET	1. CONTROL NUMBER	2. SUBJECT CLASSIFICATION (695)
	PN-AAJ-421	DP00-0000-G746

3. TITLE AND SUBTITLE (240)

Syrian Arab Republic comprehensive transport study; final report: v. VII: transport sector plans

4. PERSONAL AUTHORS (100)

5. CORPORATE AUTHORS (101)

Berger (Louis) Int. Int.; Tippetts-Abbett-McCarthy-Stratton. Enfineers and Architects

6. DOCUMENT DATE (110)	7. NUMBER OF PAGES (120)	8. ARC NUMBER (170)
1981	224p.	SY625.B496

9. REFERENCE ORGANIZATION (180)

Berger

10. SUPPLEMENTARY NOTES (500)

(Study includes volumes 1-7: PN-AAJ-415 - PN-AAJ-421)

11. ABSTRACT (950)

12. DESCRIPTORS (920)

Syria	Demand
Transportation	Organization
Finance	Investments
Sector planning	Forecasting

13. PROJECT NUMBER (150)

276000100

14. CONTRACT NO.(140)

Syria

15. CONTRACT TYPE (140)

16. TYPE OF DOCUMENT (160)

68

AID 590-7 (10 79)

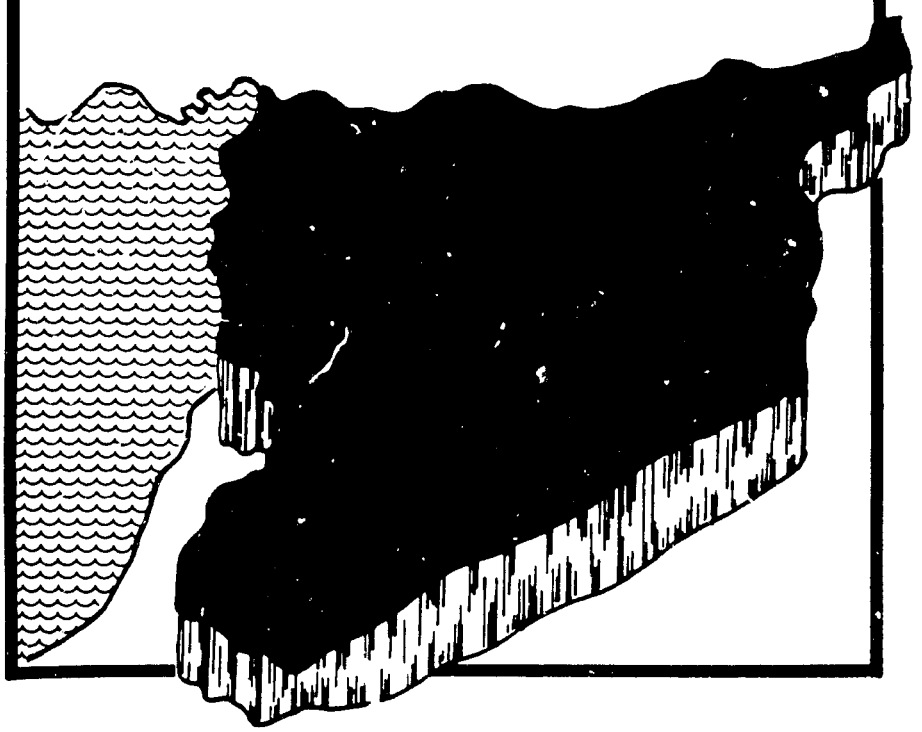
SY
625
B496
v. VII

PN-AAJ-421

MINISTRY OF TRANSPORT

SYRIAN ARAB REPUBLIC

COMPREHENSIVE TRANSPORT STUDY FINAL REPORT MARCH 1981



VOLUME VII

TRANSPORT SECTOR PLANS

LOUIS BERGER INTERNATIONAL, INC.

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TIPPETTS-ABBETT-McCARTHY-STRATTON

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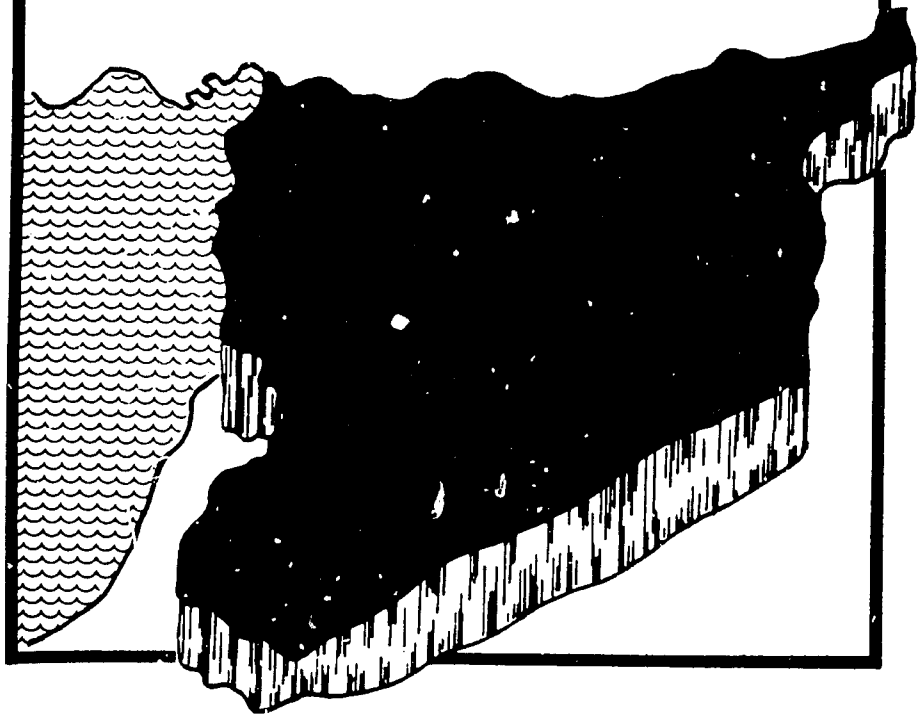

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This volume is one of seven produced as the Final Report for the Syrian Comprehensive Transport Study. The complete set of volumes is as follows:

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 VII

TRANSPORT SECTOR PLANS

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INTRODUCTION

In the volumes of this report devoted to the various modes of transport, existing conditions are analyzed, problems identified, and solutions suggested for the various modes. This volume deals with the transport sector as a whole.

In Chapter 1 systems analysis, an analytical method which enables a comprehensive approach to be adopted for transport planning, is described along with some of the major results of its application.

In Chapter 2 nonphysical policy issues are discussed in the context of coordinating operations within the transport sector to ensure optimum efficiency.

In Chapter 3, the distribution of present and future transport demand among modes is analyzed.

Chapter 4 presents an overall assessment of future transport plans and a preliminary forecast of investment requirements for the 5th Five-Year Plan and probable transport investments for the period 1986-2000.

CHAPTER 1

COMPUTER APPLICATIONS TO TRANSPORT SECTOR PLANNING

Chapter 1

COMPUTER APPLICATIONS TO TRANSPORT SECTOR PLANNING

1.1 INTRODUCTION

A set of data collection and classification procedures, computer programs, and data management systems have been developed for the Comprehensive Transport Study. The entire set is intended to analyze the various aspects of the transport sector in Syria as an integrated system comprising interrelated physical and non-physical components. The whole system has been named SYRTRANS (Syrian Transport Analysis System).

This chapter describes the overall structure of SYRTRANS and the methods used for each step. These are suitable both for the purpose of this study and for later application by the Government.

An analysis of the transport sector in Syria, present and future, following application of this computer model system is presented in this chapter.

No planning can be successful unless good and up-to-date data are available. The Consultants found it desirable to establish a computerized national transport data bank in which detailed data on the transport sector in Syria are readily available. Some of the features of the proposed data banks are identified in this report.

The entire computer work was carried out on a powerful minicomputer system installed within the Consultants' office instead of relying on outside facilities. The whole system, together with the software developed by the Consultants, has been turned over to the Government. In this chapter the background research on computer use in Syria for the purpose of determining the best computer set-up for transport sector planning is also described.

1.2 NATIONAL TRANSPORT PLANNING MODEL

1.2.1 Syrtrans Computer Simulation Model

Overview

Several steps can be identified in the systems analysis of the transport sector. Figure 1.2-1 illustrates such steps and their interrelationship.

SYRTRANS includes computer programs for each of the steps identified in Figure 1.2-1. Programs include not only those comprising the integrated multi-modal (i.e., encompassing several modes of transport) transport model but also those for processing field survey results.

The transport model must first be run using data for the current year to see if the results match the existing situation. Adjustments of factors are made until the model reasonably simulates actual conditions. This process is called model calibration. The calibrated model is then run for future years.

The basic structure of the SYRTRANS integrated transport model follows the one illustrated in Figure 1.2.-1.

For a multi-modal model such as SYRTRANS, one must decide in which step of the analysis the shares of each mode in transporting goods and people are determined.

If criteria used by an individual in selecting one mode over others to make trips or to ship goods are fully known, all modes can be treated simultaneously in a single integrated network with traffic from one point to the other traced on a route chosen according to the criteria. Complete knowledge of mode selection behavior, however, can never be actually obtained. Generalizations and simplifications have to be made. When the subject is as diversified as the whole transport sector in Syria, this simultaneous method would not produce reasonable results.

Another method is to place the modal split analysis before the trip generation step, that is, to analyze the trip generation for each mode independently. This approach is obviously not satisfactory in a situation where the competition among different modes is an important issue.

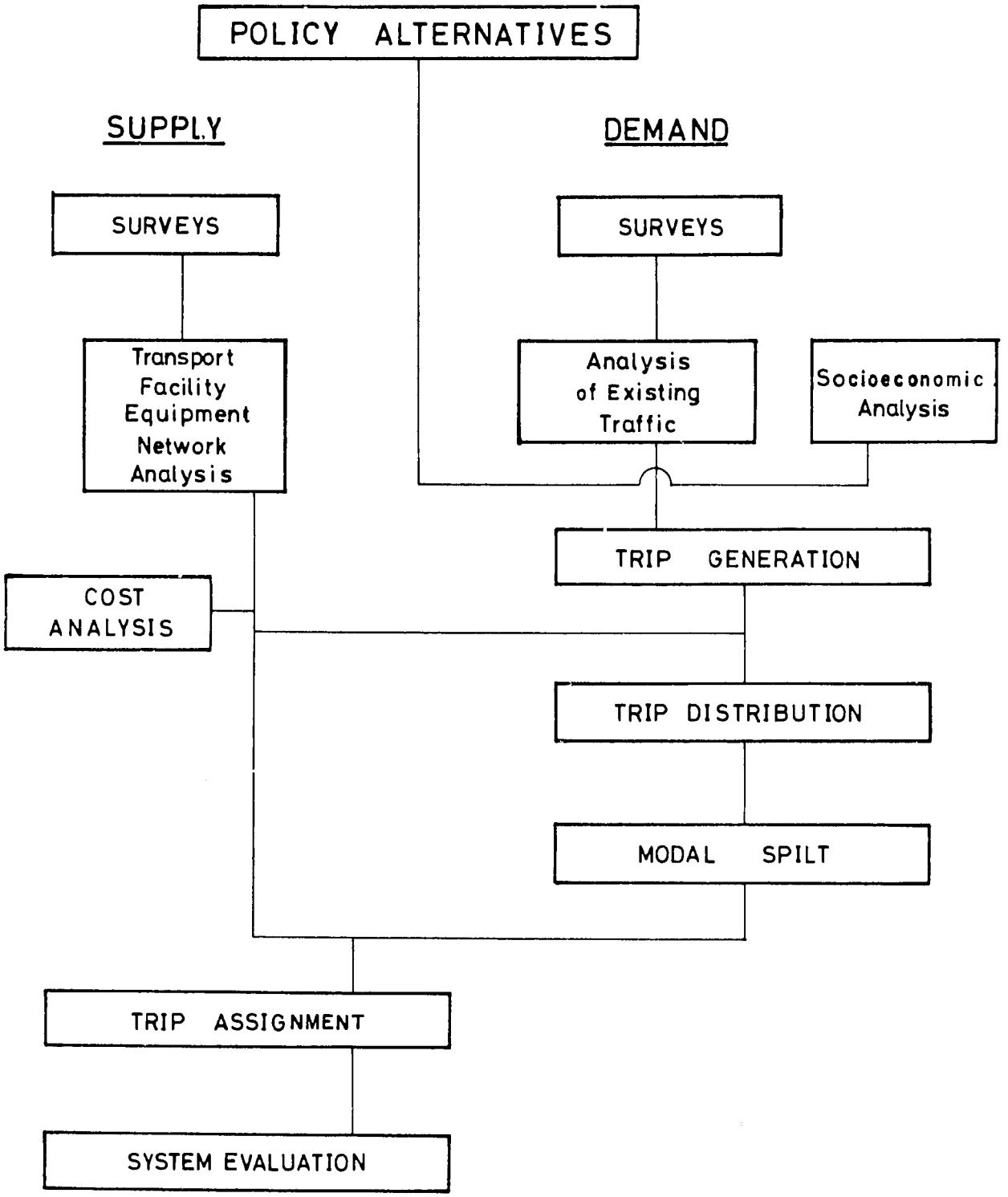
For the purposes of a national transport study, the modal split analysis is best placed between the trip distribution and traffic assignment steps. In other words, origin and destination tables should be developed for each mode by splitting the total origin and destination table. In this way, the inter-modal competition can be analyzed without losing control over traffic assignment.

Thus, origin and destination tables have been developed for each mode and the mode specific trip exchanges are assigned to the appropriate network.

In a multi-modal transport system the determination of a trip involves two decision-making processes. The selection of mode

FIGURE 1.2-1

TRANSPORT SYSTEM ANALYSIS



is made by individual users such as passengers or shippers or, sometimes, is directed to users by the Government. But the selection of routes is usually made not by users but by operators such as truckers, the railway, and bus companies. Criteria used for each process may be very different. This separation of criteria has frequently been overlooked in the past model building in order to facilitate the utilization of a single set of criteria for both the modal split and the route selection. SYRTRANS models these separately.

Trip Generation

Traffic Zones

The subject area must be divided into subareas in each of which transport characteristics are considered uniform. Or conversely, trip makers and shippers who generate trips must be aggregated to a certain level since it is simply not feasible to analyze individual trip makers separately.

Criteria for such aggregation (or subdivision) are explained in Volume II, Chapter 6. For this study, 58 zones within Syria and 22 border crossings, including ports and airports, have been delineated.

The current version of SYRTRANS allows up to 100 traffic zones. Thus, up to 20 zones can be added in the future if new border crossings or further subdivisions of some of the Manatik are established.

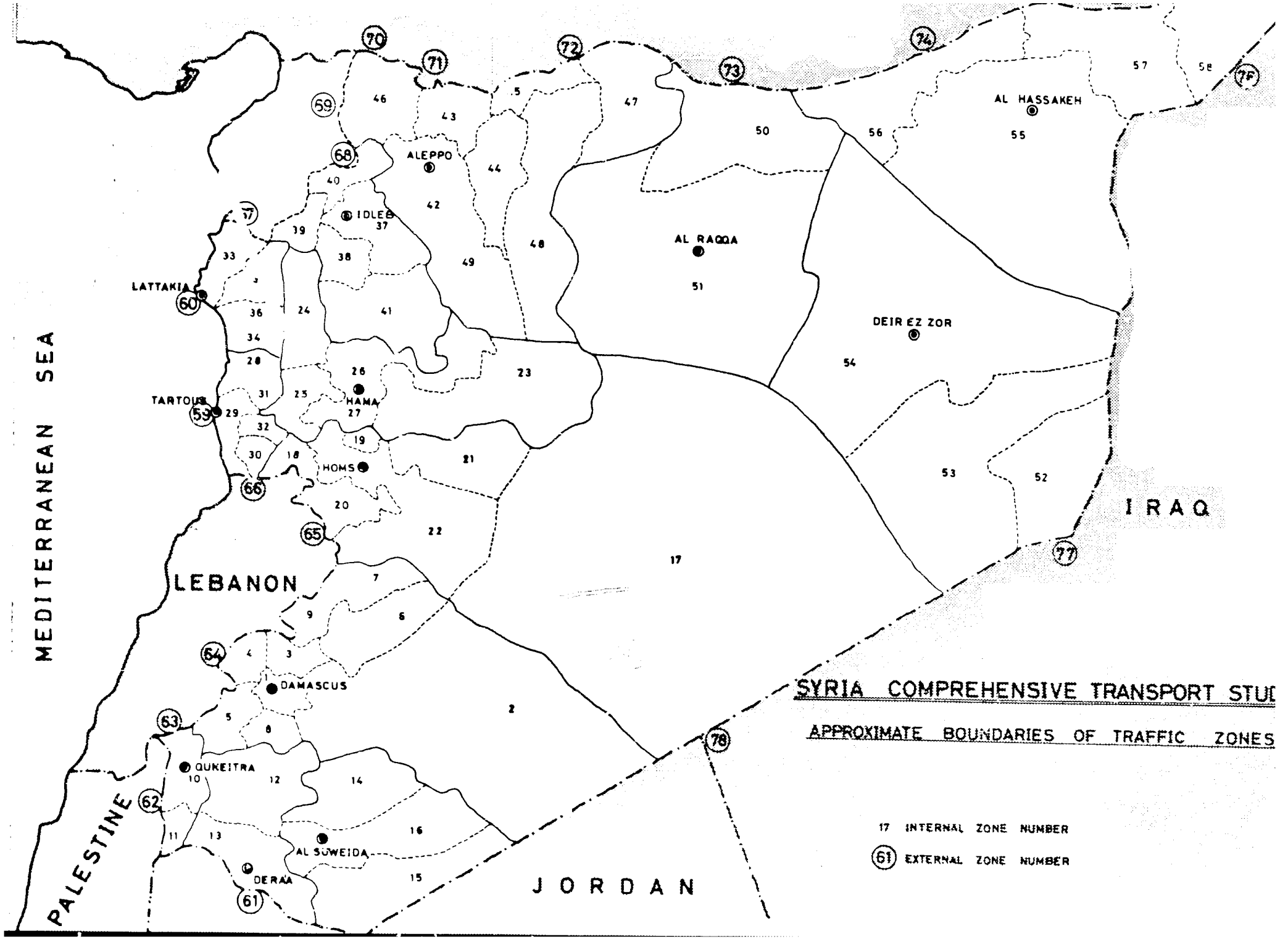
Plate 1.1 shows traffic zones and zone identification numbers used in this study.

Trip Generation Model

The objective of the trip generation step is to predict the amount of inter-zonal traffic produced in or attracted to each zone.

Various socioeconomic factors affect trip generation. Such factors can be represented by associated indicators. Several submodels can be developed to identify the interrelationships among such socioeconomic indicators and to predict their future levels and the influence on trip generation of selected socioeconomic factors.

In the case of commodity traffic, trip generation must be directly related to production, consumption, import, and export of commodities in each zone, which in turn must be related to the performance of the national economy.


SYRIA COMPREHENSIVE TRANSPORT STUD
APPROXIMATE BOUNDARIES OF TRAFFIC ZONES
17 INTERNAL ZONE NUMBER
61 EXTERNAL ZONE NUMBER
MEDITERRANEAN SEA
LEBANON
PALESTINE
JORDAN
IRAQ
LATTAKIA
TARTOUS
ALEPPO
IDLEB
HAMA
HOMS
DAMASCUS
QUKEITRA
DERAA
AL SUWEIDA
AL RAQQA
DEIR EZ ZOR
AL HASSAKEH

A model of the national economy was developed for Syria. Projections of production, consumption, import, and export levels for 51 commodities were made within the framework set by the national macroeconomic model. These are described in Volume II, Chapter 4. The estimation of commodity movements by zone that follows the above process is shown in Chapter 3 of this volume.

In the case of passenger traffic, trip generation relates to the general level of wealth and the cost of transport relative to the cost of other activities. Details of the projected passenger movements are shown in Section 3.3 of Chapter 3 of this volume.

Trip Distribution

Choice of Model

There are two types of trip distribution methods: the behavioral model method and the present pattern method. The former attempts to simulate the selection of a destination for each origin. It assumes the existence of a universal rule which all subject trips follow. The Gravity model is typical of this type.

An advantage of this method is that it can generate trips between origin and destination (O - D) pairs where no traffic presently exists. Therefore, it can be a useful tool to predict trips to and from new suburban development areas in the context of an urban transport study.

However, in the context of national transport, this assumption of a universal rule can hardly apply. Certain commodities are transported from certain zones to certain other zones for particular reasons specific to each movement. This is particularly true in Syria, where concentration of people and industry in a number of sparsely located centers is conspicuous. And the trend is for more concentration. In such instances it is more appropriate to look into the nature of particular traffic movements than to treat the country as a spatially homogeneous entity.

It was decided that the present pattern method for trip distribution would be used for this step. The future trip distribution pattern is predicted as changes from the existing pattern.

An obvious problem with any of the present pattern trip distribution methods is that they predict future traffic at zero wherever there is no traffic at present. This problem can be solved, however, by simply modifying the base-year matrix before expansion at places in the existing matrix where future traffic is expected to take place.

The Fratar method has been proved to be the most efficient computational method to obtain the future trip origin and destination matrix from the existing trip O & D matrix and growth factors of zonal trip production and attraction.

Perceived Trip Costs

Perceived Operator Cost Model

It is the costs perceived by operators that determine routes between origins and destinations. In the case of automobiles, the operators and users are often the same people, but in the other modes, operators and users are normally different.

In general terms,

$$OPC = PVOC + TOLL + TMC$$

where OPC is the operator perceived cost,

PVOC is the perceived vehicle operating cost,

TOLL is the toll charge, if applicable, and

TMC is the time cost.

For each type of vehicle used in each mode, OPC can be computed for each link of the network from characteristic properties associated with the link.

For the purpose of simulating the route selection, OPC does not need to be precise. In the absence of toll charges and closely competing routes within each mode, travel time can be used as the route selection criterion within each mode. In this study link travel times have been used.

A model of link travel time for road-going vehicles is described in detail in Volume IV, Appendix 6.7, of the Final Phase I Report.

Perceived User Cost Model

The perceived user cost (PUC) is one of the major factors affecting the selection of a mode for each particular trip from an origin to a destination.

The PUC can be expressed as follows:

$$PUC = OPC + TMC + PCC + LSC$$

where OPC is the out-of-pocket cost to the user,

TMC is the travel and waiting time costs,

RCC is the cost equivalent of reliability and comfort, and

LSC is the cost equivalent of probability of loss and damage during transport.

Included in the out-of-pocket costs (OPC) are transportation charges such as fares, tariffs, and transshipment or transfer charges. In the case of automobiles, except taxis, the OPC can be considered identical to the perceived vehicle operating cost and can be determined link by link. For the other modes, however, the OPC cannot be determined until total length of the travel path is known, since tariffs and fares are usually not proportionate to distance. If a trip involves transfers within the same mode or between different modes, total length of each leg should, in principle, be computed to be applied to tariffs and fares of each mode for the respective legs.

Time costs can be developed directly from the travel time developed by the perceived user cost computations, with the addition of allowance for comparative frequency and reliability of services.

The results of this step are matrices of inter-zonal perceived user costs for each mode and for each type of passengers and commodities.

Modal Split

The modal split model is designed to be sensitive to changes in perceived user costs of the subject and other modes and in Government policies.

Network Analysis

Network Representation

All networks are represented by links, real and imaginary. Both ends of any link are called nodes. A network can be mathematically represented by specifying connections among nodes.

All zonal centroids (Mantika centers and external entry/exit points in this study) are assigned numbers 1 through 100, the same numbers as zone numbers. All centroids must be connected to each network. All the other nodes are assigned node numbers larger than 100 but smaller than 10,000. Node numbers are not necessarily in order along routes or in sequence.

Transfer points, inter-modal and intra-modal, are represented as dummy links with associated delay times and other properties.

The following networks are represented mathematically in Phase I:

Road network	(Network type 1)
Rail network	(Network type 2)
Air network	(Network type 4)

Details of representations of each network are presented in Section 1.2.3.

Route building

Once origins and destinations of trips are identified and costs or other trip impedance of all links of a network are known, it is possible to determine routes which trip makers are likely to take between any origin and destination.

When possible routes are many and differences among them are slight, such as in the case of an urban street network, selecting a single route for each origin and destination pair may not lead to reasonable results since trip makers actually choose multiple routes in a probabilistic manner.

For a transport network of long distances such as Syria's, with almost complete lack of comparable alternative routes for any origin and destination pair, selection of a single route for each origin and destination pair can adequately simulate the reality for each modal network. In other words, all traffic can be assumed to take routes that connect origins and destinations with minimum costs.

The algorithm adopted in this study for the route-building is similar to Moore's and performs the process by means of two tables, the link cost table and the tree table. For each origin a tree table is built up by searching pertinent node numbers in the link cost table and the tree table and by comparing the sums of travel time from the origin to the subject nodes.

A great number of searching operations are involved. In order to expedite the searching process, a combination of binary search, indexing, and order chain techniques are used for this study. Because of the combined application of these three techniques, the Consultants' minimum path tree-building program is very efficient.

Traffic Assignment

Stratified Traffic Assignment

It is not appropriate to estimate the number of transport vehicles required for each origin and destination pair, since

not only tracks or roadways but also vehicles may be shared by trips of different origins and destinations on at least partly the same routes. Traffic should first be assigned to a network on the basis of number of persons or commodity tonnage.

In SYRTRANS, the O & D tables, five passenger types and four commodity types, are separately assigned to three modal networks.

Traffic volumes for each origin and destination pair are assigned to links constituting the minimum cost paths connecting each origin and destination. No second or third best routes are considered within a modal network, that is, the assignment is made on the basis of all or nothing. For the analysis of the Syrian national transport network, taking into account multiple routes for each origin and destination cannot be justified considering the amount of effort necessary to do so and the likely results.

Traffic volumes in terms of numbers of persons or tonnages are accumulated for each link until all origin-destination tables are exhausted. The resulting link records show loaded links.

Vehicular Traffic Conversion

Accumulated traffic volumes for each link are then converted to vehicular traffic.

Vehicle load factors are estimated for each vehicle type and for each trip type in each mode. For the rail mode, average train characteristics have been developed including load factors. For the road mode, vehicular traffic volume by several composite vehicle types is further converted into equivalent PCUs (Passenger Car Units) in order to facilitate a volume-capacity analysis.

Model Calibration

Whether the computer model correctly simulates the actual transport system or not can be tested by means of applying the model for a base year for which actual traffic volumes are known. If differences between the actual and the model are significant, underlying reasons are investigated, and adjustments on origin and destination tables and link impedances are made wherever justified until simulated traffic converges within a reasonable range of actual traffic.

For the rail mode the calibration is never a real problem since origin and destination data for the base year are accurate and traffic is long distance on very limited routes.

For the road mode, however, simulated traffic volumes are often smaller than the actual because the simulated traffic is only that moving between Manatik and does not include traffic originating and ending in the same Mantika. The latter is called local traffic.

In Syria there are a number of road links on which little local traffic is expected. Fifteen such links were chosen as control links against which the road transport model was calibrated. For each road link the difference between the actual traffic and counts and the calibrated model results of inter-Mantika traffic assignment for the base year (1979) was defined as the local traffic.

For the future years, local traffic was increased by local traffic growth factors developed for each Mohafaza and added to the assigned traffic volumes of the inter-Mantika traffic assignment model.

Operating Conditions and Costs

When traffic volumes on each link are obtained by the traffic assignment step, it is possible to estimate operating conditions and costs of transport facilities under such traffic loads.

For a given set of physical characteristics and operational practices of a transport link, operating speed, travel time, and operating costs are estimated. For the road mode, a detailed vehicle speed and travel time model was developed. The model is described in some detail in Volume IV, Appendices 6.5 and 6.6. It computes vehicle operating speeds and delays for each road link from the analytical description of road characteristics as presented in the next section. Operating speeds and delays are estimated for four vehicle types - cars, pickup trucks, buses, and trucks - and weighted average link travel times are computed for each link. These weighted average link travel times are used for finding the shortest paths in the road network. Effects of traffic are not considered for the initial estimates before the traffic assignment. After the traffic assignment, adjustments of speed and travel time are made taking into account reductions in average speed due to traffic interaction.

For the road mode a detailed vehicle operating cost model was developed. The discussions on the derivation of unit costs and cost changes are presented in Volume IV, Chapter 6. The model takes the link characteristics data and the unit cost data and computes vehicle operating costs for eight vehicle types on each link. The model also takes into account the cost increases due to traffic interactions.

For the rail mode, operating speeds were estimated mainly on the basis of train time schedules for each line. A simple operating cost model was established.

Investment Costs

The cost of providing a transport facility depends upon, among other things, the type of facility, the level of traffic expected to use it, and the environment. For a given set of facility types and surrounding environment, such costs can be estimated as a function of traffic.

For the road mode, two computer models were developed for this purpose, one for highway betterment and maintenance and one for road vehicle fleet expansion. The highway betterment and maintenance cost model compares physical properties of each road segment against a set of standards which are given for each of several different traffic levels.

Traffic volumes on each road segment are updated for each year, matching with the results of the traffic assignment model. Road surface conditions are updated for each year in accordance with a highway deterioration model. When certain conditions are met, the model determines the necessary action, resurfacing or widening, and calculates estimated costs for each betterment operation. Maintenance costs are also calculated as a function of traffic volume and road type. The immediate results of this model are year-by-year estimates of highway betterment and maintenance costs for each road segment.

The vehicle fleet expansion model estimates additional numbers of vehicles for eight vehicle types for each year, and subsequently the yearly investments in vehicle fleet expansion that are required to satisfy total annua vehicle-kilometers given by the traffic assignment model.

Scrapping of obsolete vehicles is taken into account in the process.

Due to the large number of road segments which must be treated separately, computerizing the investment and maintenance cost estimation is of great value. For the rail mode, however, investment and maintenance costs should be computed by manual methods.

Economic Evaluation

On one hand, the total vehicle operating costs are calculated for the base year case and for the alternative improvement assumption. The difference in cost between the two cases, cost

savings, is regarded as the benefit. On the other hand, required investments including facility construction and improvements and vehicle fleet expansion are estimated, and they are regarded as costs. Benefits are calculated for several target years, and benefits for intermediate years are obtained by interpolation or are directly calculated year by year in the case of the road mode. Year-by-year costs are also estimated.

Once the stream of annual benefits and costs is obtained, the following evaluation indicators are computed: the net present value (NPV), the economic rate of return (ERR), and the first year benefit (FYB). Definitions of such indicators and their use are given in Chapter 3 of Volume VII of the Final Phase I Report. A computer program has been developed to perform the above functions of computing NPV, ERR, and FYB for a given two sets of operating costs and investment cost stream for the base case and the alternative case.

For the road mode, a network economic evaluation model has been developed by combining the vehicle operating cost model and the investment/maintenance cost model. It evaluates economic worth of the highway betterment and maintenance program for each road segment by producing cost and benefit streams from 1979 through 2020 and calculates benefit/cost ratios. Projects are automatically screened by the FYB criterion. The model also produces total road system benefit and cost streams that are then used as an input to the total system (road and rail combined) evaluation program. The last program has been developed to evaluate the economically optimum modal split between two modes.

System Analysis and Programs

For this study more than 50 FORTRAN programs have been developed for the SYRTRANS computer simulation model.

Broadly, there are 12 steps in running the entire SYRTRANS model that the Consultants have developed. These are illustrated in Figure 1.2-2. Table 1.2-1 lists major computer programs and their functions classified by the analysis steps. Details of the SYRTRANS computer program package are being provided to the Government in a separate volume titled "SYRTRANS and Data Bank Users Guide."

1.2.2 Description of Existing Network

The Road Network

All international and national roads and all secondary roads which connect traffic zone centroids (i.e., Mantika centers) to international or national roads or traffic zone centroids

FIGURE 1.2-2

SYRTRANS GENERAL ANALYSIS FLOW

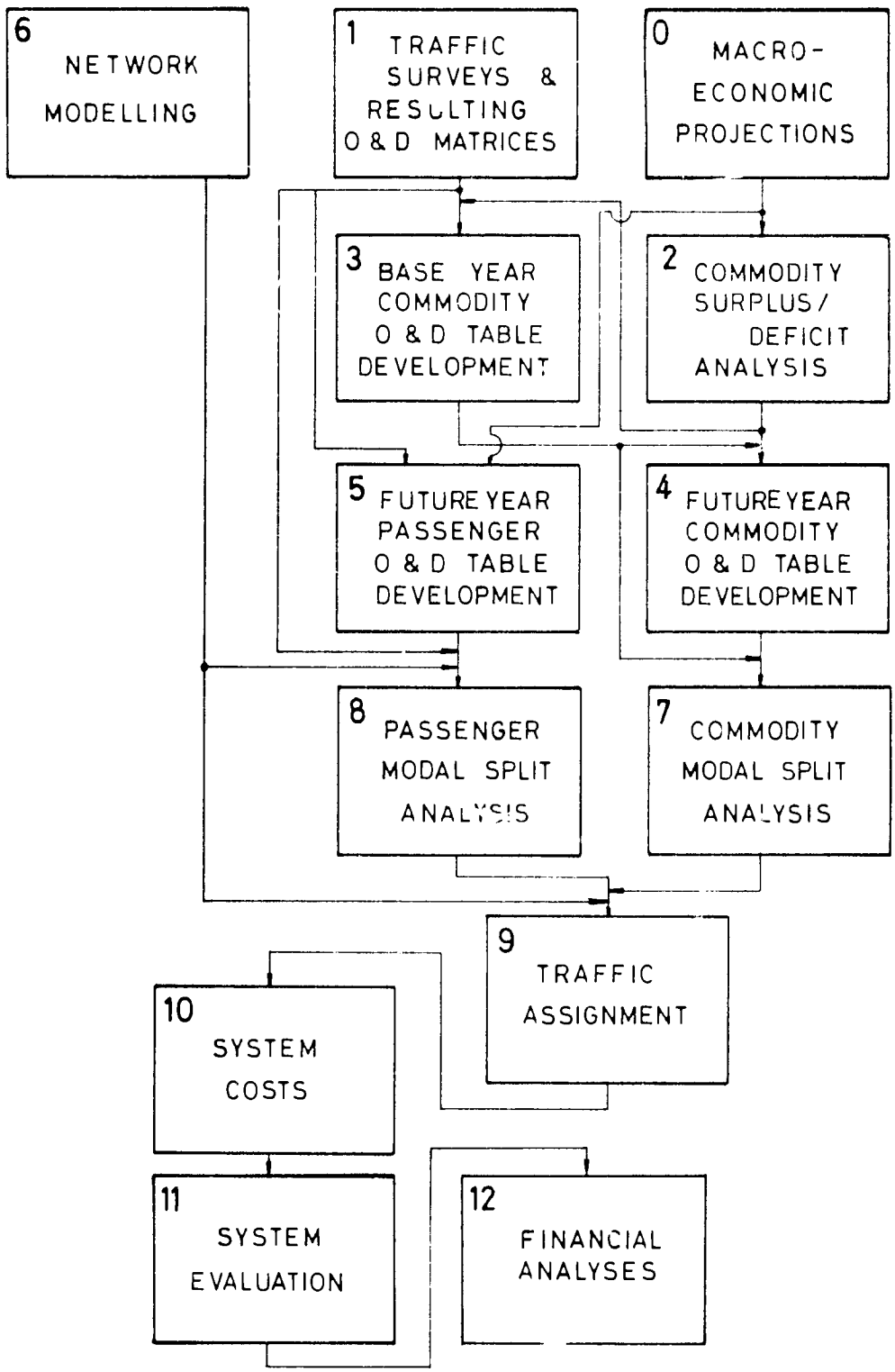


Table 1.2-1

MAJOR PROGRAMS OF SYRTRANS COMPUTER MODEL

Analysis Step	Program Name	Function
1	CHK80D	General purpose raw data file validity check.
	STAT2D	General purpose two-dimensional classification and statistics.
	TRKLOD	Truck loading statistics.
	AXDIST	Axle load distribution statistics.
	RODMXG	Road O & D survey matrix generation.
	TRKMXG	Truck ticket survey matrix generation.
	RALMXG	Rail O & D matrix generation.
	Matrix Programs	These are used in Steps 1, 4, 5, 6, 7, and 8.
	MXGNRS	Direct matrix generation.
	MXMODF	Matrix modification.
	MXFACT	Matrix factoring.
	MXDIVD	Matrix division.
	MXADDT	Matrix addition and subtraction.
	MXMNPL	Matrix arithmetic.
	MXSIMM	Matrix symmetricalization.
	MXPRNT	Matrix printing.
2	NETBLD	Network file generation.
	NETCHK	Network file validity check.
	LKIMPD	Network link impedance model.
	TREBLD8	Minimum impedance path tree building.

Table 1.2-1 (Continued)

MAJOR PROGRAMS OF SYRTRANS COMPUTER MODEL

Analysis Step	Program Name	Function
	TRSKIM	Accumulation of link attributes along minimum impedance path by link mode.
	NTINVN	Network inventory printing.
	TRPRNT	Minimum path tree printing.
	RDSTAT	Road invento y statistics for secondary roads.
	PRDSTA	Road inventory statistics for primary roads.
3	COMMODF	Zonal commodity production/consumption model.
	COMCONVERT	Zonal commodity surplus/deficit.
	COMCOMBINE	Zonal commodity group surplus/deficit.
5	COMPRINT	Zonal surplus/deficit table printing.
	COMRAT	Zonal commodity surplus/deficit growth factor calculations.
	FRATAR	Matrix expansion by FRATAR method to obtain future matrix. Also used in Step 6.
6	PASGRW	Zonal passenger trip growth model.
8	PAXSPLIT	Passenger traffic modal split model.
	SPLITF	Modal split matrix conversion.
9	ANASGN2	All or nothing traffic assignment.
	LKVOLM2	Conversions of link traffic from number of passengers and commodity tonnages to number of vehicles or trains.
	NTPRNT	Printing of loaded network.

Table 1.2-1 (Continued)

MAJOR PROGRAMS OF SYRTRANS COMPUTER MODEL

Analysis Step	Program Name	Function
10	PTRFND	Road inventory and loaded network file merging.
	PBPROG	Dynamic model of road traffic, road deterioration, road betterment investment maintenance, producing network system cost streams.
	PBLINK	Same as the above, producing link-by-link B/C ratios.
	RANKNG	Ranking of road betterment projects by B/C ratios.
11	PRESETV	Net present values and B/C ratios for a project evaluation.
	TOTCOSTS	Discounted total system costs of two-mode system.
	ECONANAL	Evaluation of alternatives for transport system.

themselves are included. All other secondary roads are excluded from the study network since all traffic is assumed to be generated and attracted to centroids.

The nodes identified on the network are:

- all zone centroids,

- all intersections and junction of roads included in the network, and

- all points where road characteristics such as those shown below change considerably.

Node identification was carried out by examining road inventory data sheets that were completed by field surveys.

For all roads leading to major cities, short links representing urban streets and highways are defined.

Links are defined by starting and ending nodes. No transfer links are included in the road network. Plate 1.2 shows the existing network and committed projects.

Railway Network

Although the network of railway lines in Syria is a simple one, the analytical network for the rail mode is a rather complex one, since it includes not only links of the railway lines but also transfer links to and from roads and links of access roads to and from zonal centroids. The network is shown in Plate 1.3.

Other Mode Networks

Because of its very different nature, the air transport network is treated independently from the road and railway networks.

The air network formulation was not used in the study as it was more efficient to make computations exogenously, but, could be applied as the network becomes more complicated.

1.2.3 Transport System Loading and Performance

Vehicle Utilization

The type of vehicles used and how they are utilized in transporting people and goods are factors deeply affecting the efficiency of any transport system. For each mode representative types of vehicles were identified along with their proportion-

ate shares in transporting people and goods, their average load factors, and annual kilometerage per vehicle. These vehicle utilization indicators give, in turn, numbers of vehicles required to transport a given amount of passengers or commodities.

Road Transport

The Consultants' road transport origin and destination surveys produced the vehicle utilization indicators shown in Tables 1.2-2 through 1.2-4. A significant percentage of passengers were transported by pickups and a sizeable portion of passengers were transported by trucks, indicating the multipurpose usage of such goods-transporting vehicles. The required numbers of trucks should be determined by commodity transport demand. Similarly, although a certain small amount of cargo may be accounted for by pickups, the amount of pickup traffic should be determined by passenger transport demand since pickups are and will continue to be used primarily for passenger transport.

It is clear that the higher the value per unit weight of a commodity, the lower the load of trucks carrying it. In all commodity groups, however, overall average loadings of trucks on roads are rather low. This results from the fact that a high percentage, roughly 50 percent, of the trucks on the road are running without any cargo. This high percentage of wasteful empty trucks on the road suggests that a significant reduction in road transport costs may be possible by managerial improvements without major investments. If the percentage of empty trucks on the road could be reduced to 40 percent, all other factors being equal, the total direct transport cost in terms of vehicle operating costs would be reduced by 20 percent.

Another possible source of road transport cost reduction is the change in the vehicle fleet, particularly the growth of combination-type trucks.

By utilizing more of the larger vehicles with lower ton-kilometer costs, the overall average ton-kilometer cost can be reduced.

The Consultants projected future truck fleet composition in Syria based on past trends and data from other Middle Eastern countries. Based on these projections of vehicle fleet composition, the Consultants then estimated distribution of commodities among different vehicle types and the overall load factors of each vehicle type for the target years of 1985 and 2000. The results are summarized in Tables 1.2-5 and 1.2-6.

For passenger-carrying vehicles, numbers of passengers were estimated for each vehicle type as explained in Chapter 3 of

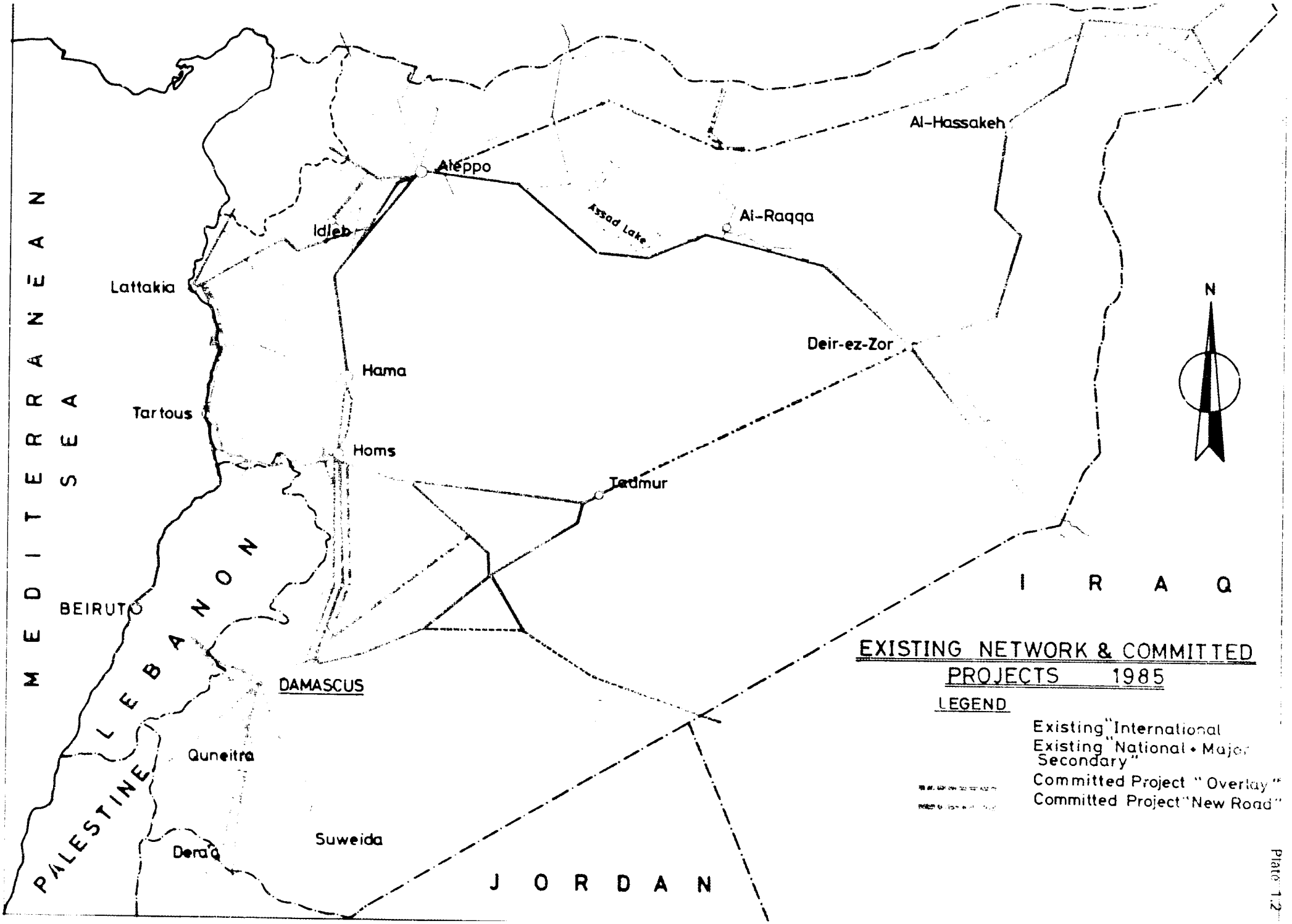

MEDITERRANEAN SEA
Lattakia
Tartous
Idleb
Aleppo
Assad Lake
Al-Raqqa
Al-Hassakeh
Deir-ez-Zor
Hama
Homs
Tadmur
BEIRUT
LEBANON
DAMASCUS
Quneitra
PALESTINE
Dera'a
Suweida
JORDAN
IRAQ
N
EXISTING NETWORK & COMMITTED PROJECTS 1985
LEGEND
Existing "International
Existing "National • Major Secondary"
Committed Project "Overlay"
Committed Project "New Road"

Plate 1.2

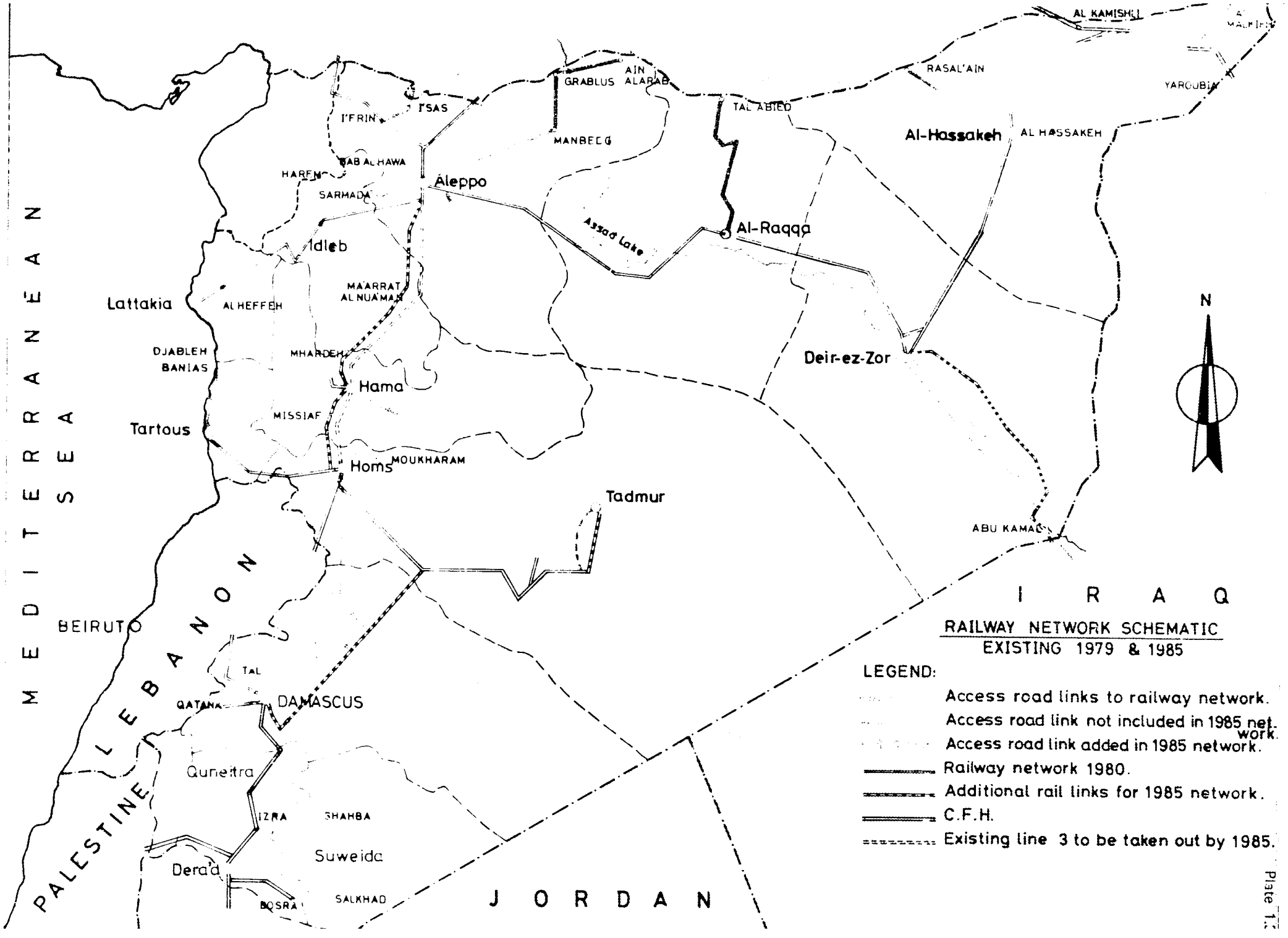

MEDITERRANEAN SEA
LEBANON
PALESTINE
JORDAN
IRAQ
Lattakia
Tartous
BEIRUT
DAMASCUS
Aleppo
Idleb
Hama
Homs
Tadmur
Al-Raqqa
Deir-ez-Zor
Al-Hassakeh
Assad Lake
Quneitra
Dera'a
Suweida
AL KAMISHLI
RASAL'AIN
YARQUBIA
TAL ABIED
AL HASSAKEH
GRABLUS
AIN ALARAB
MANBEEG
I'FRIN
I'SAS
BAB ALHAWA
HAREM
SARMADA
MA'ARRAT AL NUA'MAN
AL HEFFEH
DJABLEH
BANIAS
MHARDEH
MISSIAF
MOUKHARAM
ABU KAMAL
TAL
QATANA
IZRA
SHAHBA
BOSRA
SALKHAD
N
RAILWAY NETWORK SCHEMATIC
EXISTING 1979 & 1985
LEGEND:
Access road links to railway network.
Access road link not included in 1985 network.
Access road link added in 1985 network.
Railway network 1980.
Additional rail links for 1985 network.
C.F.H.
Existing line 3 to be taken out by 1985.

Plate 1.2

Table 1.2-2

DISTRIBUTION OF PASSENGERS AND LOAD FACTORS BY VEHICLE TYPE - 1979

	Vehicle Type					
	Passenger Car	Taxi	Pickup	Micro Bus	Regular Bus	Truck
Distribution (in percent)	34.8	21.0	13.4	9.6	13.4	7.8
Load Factor (in passengers)	3.4	4.2	1.8	13.5	37.3	1.0

Table 1.2-3

DISTRIBUTION OF TONNAGES OF COMMODITIES BY VEHICLE TYPE - 1979

(in percent)

Commodity Group	Vehicle Type							
	Pass. Cars	Taxi	Pickup	Micro Buses	Regular Buses	2-axle Trucks	3-axle Trucks	Combination Trucks
A	0	0	0.9	0	0	36.6	11.1	51.3
B	0	0	4.73	0	0	36.0	22.9	36.4
C	0	0	4.65	0	0	23.1	20.2	52.0

Table 1.2-4

AVERAGE LOADING PER VEHICLE BY VEHICLE TYPE - 1979

(in tons)

Commodity Group	Vehicle Type							
	Pass. Cars	Taxi	Pickup	Micro Buses	Regular Buses	2-axle Trucks	3-axle Trucks	Combination Trucks
A Loaded	0	0	0.92	0	0	7.6	19.3	24.7
All	-	-	-	-	-	4.35	10.1	12.9
B Loaded	0	0	1.18	0	0	5.9	21.8	20.4
All	-	-	-	-	-	3.38	11.4	10.7
C Loaded	0	0	0.76	0	0	4.5	11.9	15.2
All	-	-	-	-	-	2.58	6.20	8.0

Source: Consultants' Origin and Destination Survey.

Table 1.2-5

PROJECTED GOODS TRANSPORT VEHICLE SHARES AND OVERALL LOADING FOR YEAR 1985

	Vehicle Type			
	Pickup	2 Axle Truck	3 Axle Truck	Combination Truck
I. Distribution of Commodity Tonnage by Vehicle Type (in percent)				
Commodity				
Bulk	0.9	34.2	12.1	52.8
Intermediate	4.5	33.8	24.4	37.3
High Value	4.5	22.1	20.9	52.5
II. Overall Average Loading per Vehicle (in tons)				
Commodity				
Bulk	0.92	4.35	10.1	12.9
Intermediate	1.18	3.38	11.4	10.7
High Value	0.76	2.58	6.2	8.0

Source: Consultants' estimates.

Table 1.2-6

PROJECTED GOODS TRANSPORT VEHICLE SHARES AND OVERALL LOADING FOR YEAR 2000

	Vehicle Type			
	Pickups	2 Axle Truck	3 Axle Truck	Combination Truck
I. Distribution of Commodity Tonnage by Vehicle Type (in percent)				
Commodity				
Bulk	1.0	27.0	15.0	57.0
Intermediate	4.0	27.0	29.0	40.0
High Value	4.0	19.0	23.0	54.0
II. Overall Average Loading per Vehicle (in tons)				
Commodity				
Bulk	0.92	4.35	10.1	13.1
Intermediate	1.18	3.-8	11.4	10.9
High Value	0.76	2.58	6.2	8.2

Source: Consultants' estimates.

this volume, and numbers of vehicles were estimated by applying load factors which were assumed to remain at the present level.

Other important indicators of vehicle utilization are the annual kilometerage per vehicle and the vehicle scrappage rate. For a given total of vehicle-kilometers, these two factors determine the necessary additional vehicle fleet. Table 1.2-7 summarizes the annual kilometerage per vehicle. It should be noted that annual per-vehicle-kilometerage figures shown in this table are only applicable to inter-zonal trips and are not total kilometerages of vehicles in a year. Passenger cars and pickups, therefore, show low kilometerages since they are primarily used within urban areas or in short distances. As urbanization proceeded and car ownership increased, the average annual kilometerage of passenger cars used in crossing Mantika borders would become even less. On the other hand, annual kilometerages of goods transport vehicles would increase as the efficiency of trucking operations improved from the present low level. As shown in the table, the Consultants' estimates of future per vehicle annual kilometerages reflect such considerations.

Railways

The basic unit of railway operation is the train, one or two locomotives pulling a certain number of cars. Passenger and freight trains are differentiated. Certain types of freight cars can be used only for a specific type of cargo. For example, fuel tank cars cannot normally be loaded on the return trip. Cars designed to carry phosphate will not be loaded on the way back to the phosphate mine from the port or the fertilizer plant. As a result, trains are needed to haul back empty cars as well. The overall average load for trains, therefore, is considerably lower than that for loaded trains.

The Consultants' estimates for average load factors of railway trains are shown in Table 1.2-8. For reasons discussed in detail in Volume III, some future improvements over current load factors are assumed.

Annual kilometerages of railway cars and locomotives have also been estimated in order to determine rolling stock requirements. Results are shown in Table 1.2-9.

Vehicle Performance and Operating Costs

The operating performance of transport vehicles depends on characteristics of three aspects of transport: transport vehicles, the transport facility network, and control measures. An analytical representation of the facility network is discussed in Section 1.2.2. Vehicle performance measures were related to such network characteristics.

Table 1.2-7

VEHICLE FLEET FACTORS

	Vehicle Type							
	Passenger Car	Taxi	Pickup	Micro-Bus	Bus	2 Axle Truck	3 Axle Truck	Combination Truck
1979 Vehicle Fleet in 000's	54.9	20.9	81.3	3.8	4.8	25.1	2.5	3.4
1979 Interzonal Vehicle-Kms in Millions	545.4	518.2	287.5	270.1	142.1	531.6	100.2	229.8
1979 Annual Interzonal Trip-Kms per Vehicle in Km	9935	24793	3540	71080	29596	21179	40078	67578
Projected Annual Interzonal Trip-Km per Vehicle 1985	9370	25000	3540	71000	30000	23000	44000	70000
2000	8100	25000	3540	71000	30000	26000	49000	72000

Source: Consultants' estimates.

Table 1.2-8

AVERAGE LOAD FACTORS - CFS RAILWAY

	1979 Actual	1985	2000
Passengers-Number	300[1]	400	600
Freight-Net Tons			
Groups 1,2, and 3 Commodities		500	600
Group 4 Commodities	250[2]	250	350
Group 5 Commodities		150	250
Phosphates		820	820

Source: CFS records and Consultants' estimates.

1 Locomotive-hauled services.

2 Ordinary freight services.

Table 1.2-9

ROLLING STOCK REQUIREMENTS TO 2000

	1981-85[1]	1986-90	1991-95	1996-2000
Main-Line Locomotives	50	35	60	39
Shunting Locomotives	20	15	15	15
Coaches	300	210	215	118
Wagons	600	1,850	2,170	2,920

Source: Consultants' estimates.

1 In addition to stock on order. Stock out to tender is disregarded.

Table 1.2-10

BASIC DIRECT ECONOMIC VEHICLE OPERATING COSTS

(Syrian pounds/veh-km)

Vehicle Type	Base Speed (kph)	Motor Fuel (SP)	Engine Oil (SP)	Tires & Tubes (SP)	Maintenance (SP)	Drivers Wage (SP)	Total (SP)
Passenger Car	80	0.159	0.013	0.016	0.055	-	0.243
Taxi	80	0.168	0.014	0.016	0.050	0.198	0.446
Pickup	80	0.273	0.010	0.011	0.046	0.365	0.705
Micro Bus	72	0.194	0.013	0.018	0.124	0.295	0.644
Regular Bus	72	0.276	0.022	0.101	0.377	0.576	1.352
2-axle Truck	72	0.222	0.024	0.128	0.171	0.236	0.781
3-axle Truck	72	0.256	0.027	0.192	0.225	0.235	0.935
Combination Truck	72	0.305	0.027	0.350	0.252	0.564	1.498

Note: On level tangent class A road. See Volume IV Chapter 6 for cost increase factors in other than ideal conditions.

Road Transport Travel Time

A computer model was developed which calculated vehicle operating speeds on the Syrian road network and time delays caused by physical features of roads and traffic interactions.

Road Transport Vehicle Operation Costs[1]

Operating costs of road transport vehicles (VOC) were analyzed in considerable detail and are presented in Volume IV. Combining the results of this analysis and the analytical representation of the road network, a computerized model of operating costs of vehicles on the Syrian road network was developed. This model gives VOCs on every road link on the network for each of eight vehicle types as well as VOCs over the total network.

The model works in two steps. First, the average operating speed is estimated by applying the vehicle operating speed model described before. Basic vehicle operating costs are determined in terms of VOC on a level tangent, paved road at that average operating speed. Then the model adds incremental costs caused by road link characteristics other than the ideal condition assumed for the base costs. These steps are taken link by link for all links, and link costs are accumulated over all links to yield total system costs.

Eight vehicle types were chosen for basic costs. Table 1.2-10 shows basic vehicle operating costs. Components of basic operating costs are only those of a variable nature, such as fuel and oil consumption, wear and tear of tires and tubes, maintenance, and drivers' wages (except for passenger cars). The fixed portion of the VOC, such as insurance and depreciation, is not included since it should be included in investment costs.

Changes in VOC due to changes in operating speed can be expressed in terms of percentages to the basic operating costs which are established for bench mark speeds for each vehicle type. For the purpose of estimating changes in VOC, vehicles are categorized into four types - passenger cars and taxis, pickups, buses, and trucks - instead of the original eight vehicle types.

Cost increases due to road and traffic conditions less than the ideal condition (i.e., less than free-flow traffic on level, tangent, paved roads) are expressed in terms of percentage

---

[1]The section summarizes vehicle operating cost data used in the model. Detailed discussion of the deviation of such data is presented in Volume IV, Chapter 6 and its related appendices.

increases to the basic operating cost. These percentage figures are called Delta L factors, since they can be regarded as percentage increases in effective road length per unit length (Delta L), with the unit operating cost being set at the basic cost under ideal conditions.

Cost increases due to grades and rougher surface types and conditions are represented in Delta L factors for the different speed levels for each of four vehicle types.

Cost increases due to curves and side frictions (e.g., intersections) are represented by cost increases due to speed change cycles. Treating the effect of curves as one of speed change cycles may seem to be a gross approximation. A comparison of cost increase estimates in both cases proved it to be justified.

Cost increases due to interaction of opposing traffic on narrow roads were also counted as increases caused by speed change cycles.

As the traffic volume becomes higher, the average operating speed of vehicles in the traffic stream goes down. A number of curves have been developed to represent such relationships; they are shown in the Highway Capacity Manual of 1965 by the American Association of State Highway Officials. A simple model of traffic congestion was used in this study. It assumed a bottom congestion speed of 9 kilometers per hour and a linear speed reduction of 50 percent from free-flow condition to an at-capacity condition.

This reduction in the average operating speed is the result of numerous adjustments of speed by the driver affected by other vehicles in the traffic stream, and it results in increases in vehicle operating costs. Actual plans of submodels and values of Delta L factors associated with each of the above-mentioned cost increase factors are presented in the Final Phase I Report in Volume IV, Chapter 6 and accompanying appendices.

Railway Train Operating Speeds and Costs

Station-to-station travel time (or overall average speed) of railway trains on the Syrian railway network is more the result of operational practices than physical characteristics of the railway links. Therefore, overall average speeds as determined by the current time schedules of the CFS and CFH were used for analysis. They are shown in Table 1.2-11.

Railway cost data are not available for the CFS which warrants the development of a detailed railway operating cost model. For this study, estimated total operating costs for 1985 were compared with estimated total train-kilometers to arrive at average unit operating costs.

Table 1.2-11

SYRIAN RAILWAYS OVERALL AVERAGE SPEEDS 1979 and 1985
(kilometers per hour)

Line	Freight		Passenger	
CFS	1979	1985	1979	1985
1. Jibrin-Der Ez Zor	60	60	80	80
2. Jibrin-Lattakia	45	45	70	70
3. Vodehi-Homs II-Lebanese Border	25	60	25	80
4. Homs II-Damascus	60	60	80	80
5. Homs II-Tartous	45	45	70	70
6. Mhine-Tadmur	60	60	80	-
7. Midan Ikbis-Aleppo	30	30	40	40
8. Deir Ez Zor-Albu Kamal	-	60	-	30
9. Deir Ez Zor-Al Kamishli	60	60	80	80
10. Turkish Border-Al Kamishli-Iraqi Border	40	40	50	50
11. Lattakia-Tartous	-	60	-	80
12. Tadmur-Albu Kamal	-	60	-	80
CFH				
1. Damascus-Lebanon	20	-	20	-
2. Kadan-Military Base	60	-	60	-
3. Damascus-Jordanian Border	40	-	40	-
4. Dera'a-Palestine	25	-	25	-
5. Dera'a-Bosra	40	-	40	-
6. Damascus-Amman	-	60	-	80

Source: Consultants' estimates and CFS data.

Table 1.2-12

ECONOMIC/FINANCIAL COSTS PER TRAIN-KILOMETER 1985
(in Syrian pounds)

Component	Freight				Passenger			
	1979 Prices		1980 Prices		1979 Prices		1980 Prices	
	Fin.	Econ.	Fin.	Econ.	Fin.	Econ.	Fin.	Econ.
Movement	6.9	9.0	9.8	11.9	6.6	8.4	9.3	11.1
Nonmovement	9.8	9.8	14.2	14.2	7.4	7.4	10.5	10.5
Rolling stock depreciation	3.8	3.8	4.3	4.3	2.7	2.7	3.0	3.0
Rolling stock 12% return	11.7	11.7	13.4	13.4	6.7	6.7	7.6	7.6
Total cost	32.2	34.3	41.7	43.8	23.4	25.2	30.4	32.2
Cost in piasters per net ton/passenger kilometer	8.1	8.6	10.4	10.9	5.9	6.3	7.6	8.0

Source: Consultants' estimates.

Note: Fin. = Financial.
Econ. = Economic.

Certain percentages of these average costs were assumed to be variable with respect to traffic volume, and marginal costs, such as cost increases or decreases due to changes in traffic levels, were estimated. Details of the analysis of railway operating costs for the CFS are presented in Volume III, Chapters A-6 and A-7. Because different traffic levels require different system operations, marginal costs of railway operations cannot be considered stable over a wide range of traffic levels. The railroad operating costs are shown in Table 1.2-12.

1.2.5 Future Transport Demand

Total Demand

Commodity Traffic

For non-transit traffic, future transport demand has been estimated on the basis of changes in zonal commodity surpluses and deficits. More specifically, zonal commodity surpluses and deficits have been estimated for the years 1985 and 2000 and aggregated into three categories. Comparisons have been made between zonal surpluses and deficits in 1979 and in future years. Three cases have been differentiated.

First, when a surplus or deficit exists for a zone in 1979 and in the future years, the ratio of the surpluses or deficits for the two years is taken as the growth factor or trip production or attraction for that zone. Where no zonal surpluses or deficits, or very low levels, are estimated for the future year, with a resulting growth factor (multiplier) of a very low value, a minimum growth factor of 0.3 was assumed.

Second, where no zonal surplus or deficit is estimated for the present but a significant amount is expected for a future year, the amount itself is taken as the growth factor and the value for the base year 1979 is set at 1.0.

Third, where no surpluses or deficits are estimated for either the present or future year, the growth factor is set at the same value as the ratio of the totals of zonal surpluses or deficits over all zones for the two years, on the grounds that pure transshipment would grow at the same level as the overall growth.

The three aggregated base year commodity O & D tables were expanded by means of the Fratar method with the zonal surplus or deficit growth factors as zonal trip growth factors. Adjustments were made to the base year O & D tables to include trip exchange of 1.0 wherever the second case applied.

Six sets of commodity traffic production and attraction growth factors and future year O & D tables are available in the Consultants' offices in the form of computer printouts.

1.3 NATIONAL TRANSPORT DATA BANK

1.3.1 General

Definition

A data bank is defined as a complex of information on one sector - here the transport sector. At this level of definition, a data bank could range from a collection of technical magazines to highly sophisticated computerized airline reservation systems. There are therefore some implicit characteristics in the concept of data bank:

- The data bank is organized, i.e., the logical and functional relationships along data items are defined from the beginning and the data collected and stored accordingly.

- The data can be always updated to the latest situation.

- The data are quantitative and formated (mostly numerically).

- The data are accessible to the most frequently used computer programs (compatibility with programming languages).

- The data can be retrieved at any time according to different criteria.

- The physical storage of data tends to optimize storage space.

Practically such characteristics involve:

- The meaning of the different data items is defined, as are their function and the programs they are used for. The sources and methods for collecting data are indicated.

- The regularity, frequencies, and procedures for updating are defined and described.

- The units of measurement, accuracy, and coding instructions for data are given.

- The contents, type, and format of data files are compatible with the needs of the SYRTRANS programs.

- A set of procedures and/or adequate software is available for retrieving data and generally administering the data bank. This includes procedures for preparing adequate information outputs.

- Redundancy of data is kept to the necessary minimum.

In simple terms, a data bank in the transport sector should be regarded as a system that receives data from the pertinent agencies, that processes these data in ways that are useful for transport operations and planning purposes, and that provides information developed from the processed data ready for use by transport planners, policy makers, and decision makers. The completed data bank would consist of the following major elements:

- an organized set of procedures for developing and updating the data base,

- an organized set of data ready for use,

- an organized set of procedures for manipulating the data and producing the required information outputs, and

- an organized set of procedures for managing the national transport data bank.

General Need for Data Bank Systems

The general situation as far as information is concerned is presently characterized by some universal aspects:

- There is a growing need for information.

- Planning tasks grow more and more complex.

- Standards improve.

- There is an information avalanche.

- The quantity of technical information doubles every ten years.

- Information travels much faster now than it used to.

- The excess of information leads to a lack of information.

- The collection of and search for information becomes a main task, the use and processing of it a secondary activity.

- Work is repeated.

- Information is available but cannot be found.

The consequences of this situation are frequently:

- There are too many separate data files.

- There is a redundancy of storage.

- Data are organized only for one particular application.

- Data can be searched for only by one key.

- Lots of sorting, merging, changing are involved.

- Data are exclusively available to one user - no exchange occurs.

- Data files become data cemeteries.

- Manipulating data and related programs becomes a predominant activity.

The centralized collection and storage of data in an organized data bank is generally the only way to cope with such a situation.

Situation in Syria

The present information streams in the transport sector are far from satisfactory. They are generally characterized by:

- Data gaps. Important data, like traffic accident data or rural road inventories, do not exist.

- Inconsistent data. Because of different collection techniques, data about the same subject are widely different. For instance, import data of the Central Bureau of Statistics differ widely from port statistics.

- Scatter data. Data relevant for transport planning are scattered among several agencies. It requires a deep knowledge of the situation and much time to locate the data source.

- Unorganized data. Data are available but are not optimally filed and are frequently unformated and without any directory or cross referencing. Often, to find one particular data item or set, one must know "the right person."

- Old data. The available data are sometimes so obviously old as to be of no relevance but are kept nevertheless. Sometimes data do not reflect the latest changes.

The reasons for this situation are mainly to be found in the multitude of independent public agencies and private operators involved with the transport sector. There are 9 ministries and 23 other Government organizations involved in transport, plus 42 organizations at the Mohafaza level. In addition, there are a multitude of public, semi-public, and private operators

involved with freight transport on roads and an even higher number of bus, microbus, and service taxi operators (most of the latter are just one-vehicle operators).

The Central Bureau of Statistics (CBS), which alone has the necessary legislative power to collect data from almost all these sources, does not give the transport sector adequate weight in its publications.

The manpower, office space, and funding problems of the Ministry of Transport and the State Planning Commission are too severe for the organizations to act consistently as a central data agency. Neither of these agencies has electronic data-processing capabilities.

The positive aspects of the Syrian situation should be mentioned as well:

- There is generally a readiness, especially with public agencies, to share data.

- Basic statistics that are of interest to the transport sector, such as demographic statistics and national accounts, are collected to a fair extent with up-to-date techniques by CBS and are processed and summarized yearly in the statistical abstracts.

- The Consultants have collected a great deal of data for the present study and have checked, revised, and updated existing data, including those contained in previous studies related to the transport sector. Most data were formalized, quantified, coded, and transferred onto electronic storage devices. Forecast data up to the year 2000 were also generated.

- A minicomputer will be available to the Government from mid-October 1980. Syrians have been trained in computer basics and programming as well as in computerized transport planning techniques, and their training is expected to continue.

Advantage of a Transport Data Bank

Several aspects of transport planning could be made easier, faster, more accurate, and more reliable by an efficient data bank, which would have the following advantages:

- The availability of comprehensive data, i.e., data allowing the consideration of the transport system as a whole, makes it possible to assess present and forecast future transport demand, anticipate bottlenecks, analyze and evaluate alternative proposals, prepare plans and policies, and otherwise aid in the development of solutions to existing and likely future transport problems.

- The availability of easily accessible and retrievable data, ready for use, expedites undertaking studies and preparing reviews. Identification of projects, development of programs, completion of feasibility studies, securing of financing, and implementation of projects are accelerated. Misuse and waste of the limited time of professional personnel on data collection and elementary analysis can be reduced or avoided. At present when data of this kind do exist, they are scattered among the various sources, many of them are not published or in print, and they are frequently outdated almost as soon as they are available. The total is so voluminous that the selecting, sorting, and summarizing of particular groups of data for answers to particular questions or to meet the requirements of a particular analysis or investigation is so time-consuming that many important questions must go unanswered and many investigations and analyses cannot be undertaken.

- A unified transport data base enables servicing of the data requirements of project reviewers, analysts, and planners from a common data pool. Alternative transport plans, terms of reference, proposals and projects, whether prepared by Government staff or consultants, can be based on common data. Different consultants and staff could avoid making varying or inconsistent assumptions caused by the absence of an organized set of information. Different proposals or projects can be evaluated on the basis of actual merits without being obscured by differing views as to what the basic facts are. At present, diverse sets of data containing contradictory information (because of differences in definition, compilation, etc.) make these things very difficult.

- An organized set of transport data can be rapidly manipulated and large amounts of data can be analyzed or synthesized according to different viewpoints; and the planning and development process can be sped up, earlier improvements achieved, and savings realized.

Considering the present deficiencies and the possibilities opened by the present study, the implementation of a fairly scaled national transport data bank seems both feasible and advisable.

1.3.2 The National Transport Data Bank

Functions of a Transport Data Bank

The general purpose is obviously to offer a constant back-up to planners (be they in Government agencies or consulting firms) and decision makers with fast, up-to-date, consistent, and handy information about the transport sector. There are basically three types of functions which can be thought of for such a data bank in Syria:

A) Provide the necessary input data for running the programs of SYRTRANS model, that is, for preparing the whole or part of the forecasts and economic and financial evaluations performed by this model.

Such a repetition should take place if unexpected developments occur and to test the impact of differing policy decisions. Data of this kind must conform to the requirements of SYRTRANS; otherwise, either the programs must be changed or the influence on final results must be taken into consideration.

B) Provide the data bank users with detailed data, or data on tap, that is, with data describing one or a few particular aspects of some part of the transport sector in setting general policies and in preparing or reviewing budgets.

This kind of information could be, for instance, the number of lanes of a particular highway link or the traffic on a particular railway line.

The data should be retrieved from the data bank either directly or by the application of elementary arithmetic or statistics (sums, averages).

The use of such data is mainly for such purposes as the identification of individual gaps or deficiencies, definition of individual projects, project review and screening, and location choice.

C) Provide data bank users with comprehensive data, i.e., with data describing some overall aspect of the transport sector or one of its parts, be it a region, a mode, etc. This kind of data would include such information as total national kilometerage of highways by surface type, the number of links of all unpaved secondary roads in a certain Mohafaza where the traffic exceeds 200 vehicles a day, etc.

The data can be extracted from the data bank either directly by performing some elementary arithmetic (count, summation), statistics (average), or logical comparisons.

The use of these data is mainly for preparing reviews, summaries, and yearly reports, contributing to international statistics in the identification of major gaps in the system.

A fourth type of data is used for typical engineering tasks, such as road design, construction, maintenance, and cost estimates. These data are usually gained from field work and surveys, but they differ in nature, disaggregation, and precision according to the specific utilization. In this study, a great deal of inventory data were collected, mostly by visual observations. All of them are recorded on specially designed

inventory forms and filed in several dozen filing binders in an orderly manner. These data are easily retrievable, although they are in paper form.

Scope of a Transport Data Bank

The definition of the scope follows from the categorization of existing data.

1. A very large group of data was used in Phase I and Phase II of the present study to calibrate and to perform the forecasts with the SYRTRANS model. These data are logically structured and organized, are quantitative, coded, and computerized. They are immediately ready for function A.

2. This same group of data contains a lot of direct information suitable for functions B and C. The only limitation is that because the data are organized in a fashion best suited to SYRTRANS programs, they are not always directly accessible, readable, or understandable for other purposes.

3. Another group of data was not directly used in the framework of SYRTRANS but was used by other computer programs to produce reports or generate some of the input data for SYRTRANS. These data also contain a great deal of direct information suitable for functions B and C and are quantitative, coded, and computerized. The place of these data in the general structure is presently not defined, and being aimed at one particular purpose, they are not always directly accessible, readable, or understandable for other purposes.

4. Some data which were used directly by experts without being run through computer programs are nevertheless quantitative and coded. Again, their quantification and coding was aimed at one particular application, so although they are generally suitable for functions B and C, they may not be directly useable.

5. Many data are contained in the reports, working papers, and files of the present study, mostly in the form of tables. They are suitable for functions B and C, are quantitative, and not being coded, are understandable, but their logical organization suits primarily the specific purposes they were used for.

6. A large amount of additional information is contained in reports, papers, and files, but it is mostly simple, unformalized, and not always quantitative. This information is theoretically suitable for functions B and C.

7. Some data that are relevant the transport sector and suitable for functions B and C were not, or could not be, collected in the present study and thus are not readily available. Examples are traffic accident and budget data.

The following definition of scope is in conclusion derived from this situation.

- The data bank will in its first implementation contain all data from categories 1 through 4. The general logical organization of the data base as well as sufficient data descriptions permit the use of these data for direct information.

- The place of some of the category 5 data in the general logical structure will be given together with the recommendation to establish adequate descriptions and instructions for putting them in the data base at a later stage with the purpose of using them for functions B and C.

- General recommendations on extracting or collecting data of types 6 and 7 are given. The definition of their place in the logical structure as well as their actual implementation may take place at a later stage.

Computerization

Data bank applications on a large scale were not possible before the breakthrough of computers and of data management software, so there has historically been an intimate relationship between data banks and computers.

The advantages of storing millions of information units in just a thin layer of magnetic substance, of searching and retrieving information in infinitesimal fractions of seconds, etc., are too obvious to be described here in detail. The four main advantages of combining data bank and electronic data processing (EDP) can be briefly recapitulated as follows:

- The quantitative aspect: Enormous quantities of data can be stored and administrated.

- The qualitative aspect: There is exact and, in case of repetition, always identical results of processing.

- The temporal aspect: There is very high speed in the processing of data.

- The spatial aspect: Data can be inserted or retrieved from decentralized locations without a significant loss of time.

All this notwithstanding, under circumstances similar to those in Syria (little EDP support, lack of trained personnel, no previous experience in computerized data bank applications), the recommendation of computerizing a data base is not always as straightforwardly advisable as it would seem.

The difficulties in implementing, and particularly of keeping a highly computerized data bank functioning, are tremendous and should not be underestimated.

In some cases, therefore, a small, well-organized manual filing system, although slower, has been recommended. No particular skills are required for personnel, filing cabinets do not have system breakdowns or react to electricity voltage fluctuations, and most important of all, data can be seen. Misplaced or lost data can be found or regenerated even if the process is cumbersome.

Again, the fact which leads to the recommendation for a computerized transport data bank for Syria is the availability of both computerized data and an available computer.

Not only has much of the main work of collecting, quantifying, coding, entering, and organizing already been done, it would be difficult and cumbersome to translate the data back into a form compatible with a manual filing system.

In addition to this, the available Zilog MCZ5, if not comparable in its size, performance, and software with main-frame computers, nevertheless provides adequate support for a data bank of the size which is aimed at here. The small computer, dedicated to just one task, in contrast to the multi-task, multi-user large computer, corresponds to the latest development in computer techniques. The software developed by the Consultants along with the manufacturer-supplied software, such as the Text Editor, provide adequate support for the computerized portion of the data bank with its current size.

As for the availability of personnel, Syrians have been trained in EDP, programming, the use of SYRTRANS, and basics of data banks. In addition to this, the Consultants' experience with Syrians as supporting staff for computer activities has shown that the transmission of know-how is not difficult, due to the excellent level of general education.

1.3.3 Structure of a National Transport Data Bank

Prior to the start of data collection for a data bank, the organization of data must be defined, i.e., which individual pieces of information are to be stored and how they are logically related to each other.

Definitions

- The definition of the elementary information is given by a data item. A data item may have one or more occurrences distinguished by an attribute, each having a value. A data item is physically stored in a column if it is stored manually or in a field if it is stored on a computer storage device.

For example, in the population file in Figure 1.3-1 "Mantika," "Urban Population," etc. are data items; "Mantika" has 58 occurrences with values "Greater Damascus," "Douma," "Tal," etc. "Urban Population" has three occurrences: "Urban Population 1979," "Urban Population 1985," "Urban Population 2000," etc.

- The data group is a set of logically related dissimilar items. The logical relation normally implies a hierarchical ranking. Groups are contained in a line in manual storage and in a record in computerized storage. In our example, the complex Mantika-Urban Population-Rural Population with their subsets is a group.

- The data entry is a set of one or more groups that is not subordinated to another group. Entries are stored in folders in manual storage, on elements in computerized storage. In our example, the whole complex shown is an entry.

- A data file is a set of one or more independent entries.

- A data base is a complex of different files referring to one sector.

- A data bank is a set of data bases provided with the necessary accessories for administrating it.

If the different data items are followed from top to bottom in Figure 1.3-1, it can be seen that they are arranged on different levels - the hierarchial levels.

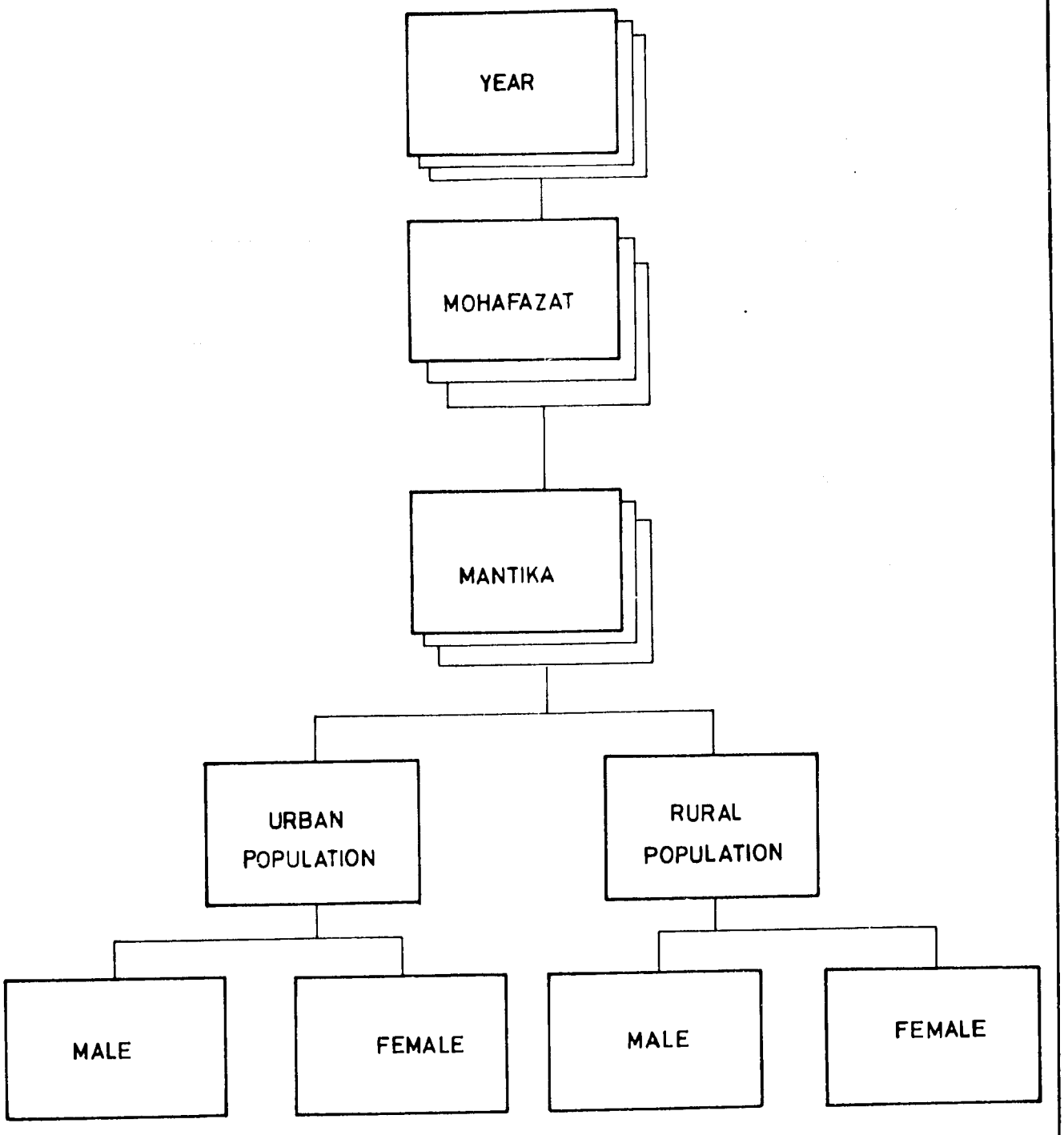
Files

The decision on how many and what kind of files to insert in a data base is governed by contrasting aspects.

It would be theoretically desirable to have as many files in the data bank as are necessary to describe the transport sector in all its aspects. Unfortunately, the possibility of implementing a data bank, its operability, and its flexibility more than linearly decrease with the number of files contained. A cross-referencing system, for instance, grows not as the number of files increases but as the number of their permutations

FIGURE 1.3-1

POPULATION FILE STRUCTURE



increases; if the amount of cross references is C for two files, it would be 10 C for 5 files, 45 C for 10 files, and 1,225 C for 50 files.

It would be desirable to have self-sufficient files, each one fully describing one aspect of the transport sector. These files would become quite large, and many data items relevant to more than one aspect would be stored in more than one file, leading to an undesirable redundancy of data.

A compromise is proposed considering the data available and the possibilities of the computer and the personnel. The Consultants therefore recommend a small but functional and implementable data bank. The size of files is also to be kept fairly small to minimize redundancy.

The Consultants recommend that initially the Syrian transport data bank include:

- converter files, which are files without major significance for themselves but which are indispensable for converting data of other files and to link different files to one another,

- transport demand data, including both the desired transport flows and the assigned volumes,

- transport infrastructure data, where infrastructure is defined as the complex of physical, generally unmovable facilities on or through which transport flows occur, including those facilities necessary to regulate the operation,

- transport vehicle data, where the characteristics of the most common vehicles used in Syria are described,

- transport operator data, including all categories of operators involved in passenger or commodities transport even if their main activity is not in the transport sector,

- other transport data, including such data on the transport sector that do not fit in any other categories,

- transport project data, including not only infrastructure projects but also projects affecting vehicle operation or maintenance other than ordinary replacement and maintenance, and

- socioeconomic indicators, including such data as are useful for consistency checks, forecasts, etc. of transport data.

These data will be organized in files according to the transport modes:

- road

- rail

- air, and

- others (pipeline, maritime shipping, ports, storage), if relevant, otherwise they wil be organized in just one general category.

The general organization of the data bank files is shown in Table 1.3-1. The key to the code numbers of files is given in the following paragraph.

Coding System For Data Items

Every data item has a 6-digit code. The first three digits refer to the file:

- The first digit is related to the type of data contained in the file:

- 0 Converter files
- 1 Transport demand
- 2 Transport infrastructure
- 3 Vehicles
- 4 Transport operators
- 5 Other transport data
- 6 Transport projects
- 7 Socioeconomic indicators

- The second digit refers to the mode:

- 0 General
- 1 Road transport
- 2 Rail transport
- 3 Aviation
- 4 Other modes

- The third digit indicates the sequential number of the file within one same combination of the first two digits. It is a 0 if the file is the only one, otherwise, 1, 2, 3, etc.

- The fourth digit indicates the hierarchical level in the particular file where the data item is located.

Example: Data item number 211104 indicates that the data item number 4 (in this case link length) on the first level of the first file contains data about highway (1) infrastructure (2).

Table 1.3-1

ORGANIZATION OF FILES IN THE TRANSPORT DATA BANK

Mode Type of Data	General	Road	Railway	Air	Other
Converter 0	001 Zoning 002 Commodity Classification				
Transport Demand 1	101 Passenger O-D matrices 102 Commodities	111 Road O-D matrices 112 Road traffic	121 Railway O-D matrices 122 Railway traffic volume	131 Air O-D matrices	141 Ship arrivals/departures
Transport Infrastructure 2	201 Construction & maintenance unit costs	211 Primary Road Inventory 212 Secondary Road Inventory	220 Railway Inventory	230 Airfield Inventory	241 Port Inventory 242 Pipelines
Transport Vehicle 3	301 Speed Model Input 302 VOC Components	310 Road vehicle characteristics	320 Rolling stock characteristics	330 Aircraft characteristics	
Transport Operators 4		411 Private vehicle fleet 412 Passenger transport operators	412 Railways	430 Syrian-air	441 Port-authorities 442 SADCOP
Other Transport Data 5		510 Road Accident Data			
Transport Projects 6	600 Intermodal	610 Road Investment & maintenance	620 Rail Investments	630 Aviation Investments	641 Port Investments 642 Pipeline Investments

Table 1.3-1 (Continued)

ORGANIZATION OF FILES IN THE TRANSPORT DATA BANK

Mode Type of Data	General	Road	Railway	Air	Other
Socioeconomic Indicators 7	701 Population 702 Labor Force 703 GDP 704 Surplus Deficit				

1.3.4 The Data Management System

The Data Management System (DMS) has been developed by the Consultants to support the national transport data bank. It covers a part of the computerized portion of the data bank. It should by no means be treated as the whole of the data bank or even the whole of the computerized portion of the data bank. Nevertheless, it has been designed flexibly enough to permit expansion without much difficulty, and such expansion is recommended.

The DMS consists of specifically named data files, direction files, and controlling software.

The DMS performs the following functions, and it can be applied to a wide variety of data:

- Enter data items.
- Retrieve data items.
- Delete data items.
- Sum and average selected records.

The user may specify certain keys for selected data items, then the system searches data records which satisfy such specifications and performs the above functions for the selected records. Up to two files can be searched at the same time. Directory files are automatically updated.

Details of the DMS are presented in the SYRTRANS and DMS users guide.

1.3.5 Future Needs

During the course of the study a great deal of data were collected, generated, and compiled. Computerized data alone amounts to more than 3,000 files totalling 17 million bytes. To print these data on paper the size of this report would require more than 5,400 pages. In addition, there are infrastructure facility inventory sheets in two dozen binders and folders and numerous reports collected from various transport-related agencies. There is also a large amount of factual data, mostly in tabular form, contained in the reports of this study.

This is the first time in Syria that transport-related data have been collected and compiled in an organized fashion with this comprehensiveness and detail. All of the data, computerized or not, will be turned over to the Government, together

with the related computer software. If no action is taken by the Government to maintain and update this large amount of data, all of it will soon be inaccessible and thus useless.

The Consultants recommend the establishment of a national transport data bank section within the Government. Its functions would be:

- to train its staff in the maintenance of the data bank the Government is receiving from the Consultants,

- to establish routine data-updating procedures in cooperation with agencies producing the original data,

- to establish routine data-reporting procedures in cooperation with agencies which are present or potential users of such data, and

- to expand the data bank, computerized or not, thus upgrading the level of its services.

The initial staffing of the section would be:

- a section chief

- two professional-level analysts, and

- five data-handling and filing clerks.

Because of its highly advanced nature, particularly in the computerized portion of the data bank, it is essential to have an expert's technical assistance for at least the initial year, and probably for the first two years of the section's operation.

The technical advisor would not be confined to computer usage but would be required to work with data bank input and output in the broadest sense. His task would be to advise and assist the Government in setting up a viable data bank section within the Government.

Since the section's successful operation involves, or depends so much on, other agencies' cooperation, it is desirable that the expert be comfortable in dealing with delicate inter-agency relations.

Of the 39 items or areas identified in Table 1.3-1, one-half have already been computerized. Computerization of the remaining 18 items should also be included in the major tasks of the data bank section. These items are listed in Table 1.3-2.

Table 1.3-2

INFORMATION ITEMS RECOMMENDED FOR FUTURE COMPUTERIZATION

Code	Description and Comment
141	Data on arriving/departing ships and the cargo.
201	Construction and maintenance unit costs Summary data already computerized. Survey data are desirable.
230	Airfield Inventory.
241	Port Inventory.
243	Storage facilities.
249	Intermodal transfers.
310	Road vehicle characteristics.
320	Rolling stock characteristics.
330	Aircraft characteristics.
411	Private vehicle fleet statistics.
412	Inventory of passenger transport operators.
413	Inventory of freight transport operators.
421	CFS operating information.
	CFH operating information.
510	Road accident statistics.
610	Road project-by-project information.
620	Rail project-by-project information.
641	Port project-by-project information.
642	Pipeline project-by-project information.

Note: Most of the above information has been compiled manually by the Consultants.

The Zilog MCZ-1 computer system turned over to the Government will be adequate for the expanded national transport data bank for the immediate future.

1.4 COMPUTER USE FOR TRANSPORT PLANNING IN SYRIA

1.4.1 Selection of a Computer

An analysis of data processing capabilities in Syria and the process of selecting a computer for use in this study were presented in Volume VII, Section 1.4 of the Final Phase I Report.

In summary, the Consultants concluded that the advantage of carrying out computer work with daily contacts within Syria would outweigh the disadvantage of having to use a mini-computer system instead of the main-frame computer systems and technical support available in the U.S. Based on the analysis referred to above, and with the concurrence of the Ministry of Transport, the Consultants purchased a Zilog MCZ-1 system. (A second Zilog system was rented for five months during Phase II to accommodate the heavy programming and computation workload.)

The selection of the Zilog MCZ-1 proved to be a rewarding decision for the study. Due to its far superior software (this is mainly because the Zilog is one of the newest systems in this rapidly advancing field), the Consultants were able to develop a computer model with capabilities almost as good as models developed for large main frame computers, except for processing speed and capacity, which were not constraining factors in this study.

The current version of the SYRTRANS programs can handle up to 100 traffic zones and 2,500 network links. If the number of traffic zones or links exceeds these limits, a larger computer system will have to be brought in. This should not occur in the near future, however, considering the size of the data base sufficient to model the transport sector in Syria. The same can be said of the national transport data bank.

1.4.2 Training Requirements

In response to the Government's request, the Consultants initiated a training course in computer analysis in the Consultants' office in early July 1979 for several appointed Government counterparts.

Training sessions were held regularly two days a week through January except for a one-month period after Ramadan. The appointed counterparts initially numbered seven, but only four participated in the training sessions in the latter months.

Due to the heavy use of the computer for the preparation of the Phase I Report, the training course was suspended from December 1979 to April 1980. It was resumed in May 1980. This time, the course took place three mornings a week with equal emphasis on programing and SYRTRANS usage. Sessions were held until the end of August 1980. Two of the four trainees were chosen to be sent to the Consultants' head office in the U.S. to receive further training for eight weeks.

This amount of training is not sufficient to qualify inexperienced personnel to operate the SYRTRANS system. The Consultants believe that unless an intensive on-the-job training program is implemented for concerned Government employees, the productive use of the SYRTRANS system by the Government is not likely to take place. It is strongly recommended that the Government hire a well-qualified local computer expert to serve as a nucleus of such a program. This individual might be obtained from another Government agency, such as the Central Bureau of Statistics, or from the private sector.

CHAPTER 2

SUPRA-MODAL ORGANIZATION AND FINANCE

Chapter 2

SUPRA-MODAL ORGANIZATION AND FINANCE

2.1 ORGANIZATION OF, AND RESPONSIBILITIES FOR, TRANSPORT

2.1.1 Findings and Recommendations

Basic findings are discussed in this subsection.

Although there are a large number of ministries and agencies involved in the transport sector, the Consultants have not identified problems that would justify either a major reorganization of the sector, the creation of a single overall transport ministry, or the creation of a new coordinating council or other mechanism above the ministerial level.

Some changes are needed in the assignment of responsibility and in procedural improvements. They fall principally into five areas:

- planning, including manpower planning,
- the national transport data bank,
- road construction and maintenance,
- tariffs, and
- vehicle operating costs.

The MOT organization is unduly fragmented and is not adequately structured to support its primary responsibilities.

Personnel shortages are a serious problem in many parts of the transport sector, with the shortage of qualified personnel in MOT being particularly acute. The generally recognized problem of low Government salaries has seriously affected the transport sector, where improved management is urgently needed. Personnel shortages, low morale, and low productivity are the results. In addition, personnel management generally needs to be made more systematic, and there is an urgent need for training at all levels.

The Consultants' recommendations are as follows:

- The Supreme Planning Council and its supporting arm, the State Planning Commission, should remain the only point in Government where full inter-modal transport planning occurs. The next step in the development of transport planning within the Syrian Government should be to implement the type of demand-oriented planning used to develop this report. The main tools and approaches in the system are incorporated into SYR-TRANS, an integrated computer transport planning model specifically developed for Syria. The model and its components are described in Chapter 1 of this volume.

- Mechanisms should be established to ensure that the basic data, such as O & D surveys, traffic counts, and the road and other modal inventories collected by the Consultants in Phase I, are kept current on a continuing basis.

- The Government should make an early decision on the future location of the national transport data bank and the SYRTRANS model. The SYRTRANS model is a planning system. It, and the national transport data bank, will require input data ranging from socioeconomic forecasts to traffic counts, which must be regularly obtained from a variety of organizations. The systems will also serve these organizations by providing analyses they require. For these reasons, the Consultants recommend placing this responsibility in the State Planning Commission.

- The responsibilities for road planning, construction, and maintenance for all roads should be recentralized in the Ministry of Communications, with the Directorates of Communications in the Mohafazat reporting directly to the Ministry. (This subject is discussed in detail in Volume IV, Chapters 2 and 3.)

- The MOT's authority with regard to tariffs should be clarified and its capability strengthened. Formal procedures should be established to ensure that tariffs are regularly updated with competing interests fully considered.

- The MOT should be assigned responsibility for establishing vehicle operating costs to be used by all Government agencies, and a capability to do this should be created in the Ministry.

- The MOT should be reorganized to bring its organization structure and capabilities into conformance with its basic responsibilities for the subordinate transport agencies and to lessen the burden now placed on the Minister and his Deputies. (An alternative MOT organization is shown in Figure 2.1-1.)

- The Government should seek means to increase the professional staff of the MOT whose training and experience are directly relevant to their assigned work.

- The need for improved management is one of the most pressing transport problems in Syria today. A much wider use of incentive salaries, particularly in the operating agencies, should definitely be studied further.

- Beginning with the MOT, personnel systems based on position descriptions that include duties and qualifications and on regular performance appraisal should be established in those transport organizations that do not now have them.

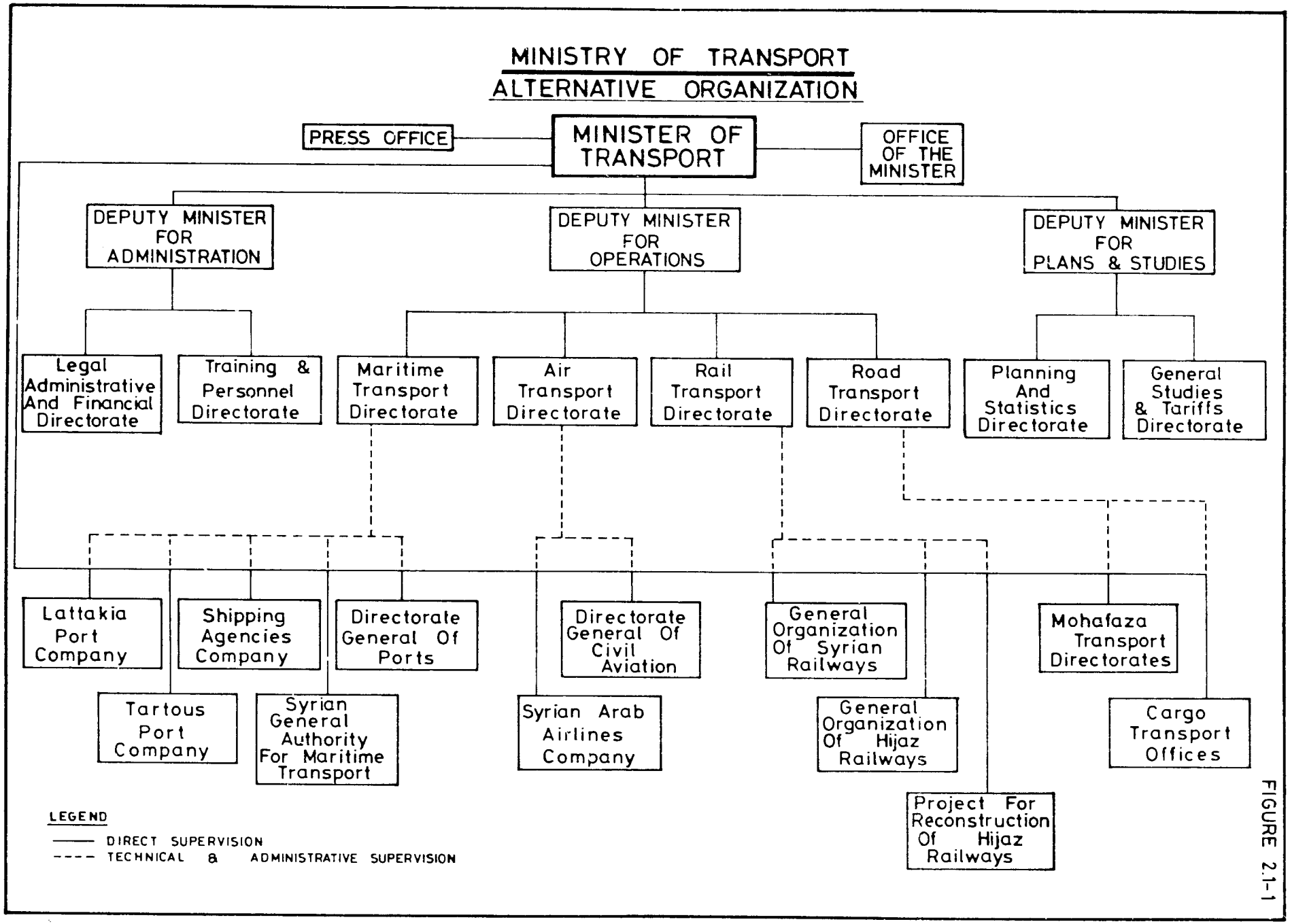

MINISTRY OF TRANSPORT
ALTERNATIVE ORGANIZATION
PRESS OFFICE
MINISTER OF TRANSPORT
OFFICE OF THE MINISTER
DEPUTY MINISTER FOR ADMINISTRATION
DEPUTY MINISTER FOR OPERATIONS
DEPUTY MINISTER FOR PLANS & STUDIES
Legal Administrative And Financial Directorate
Training & Personnel Directorate
Maritime Transport Directorate
Air Transport Directorate
Rail Transport Directorate
Road Transport Directorate
Planning And Statistics Directorate
General Studies & Tariffs Directorate
Lattakia Port Company
Shipping Agencies Company
Directorate General Of Ports
Directorate General Of Civil Aviation
General Organization Of Syrian Railways
Mohafaza Transport Directorates
Tartous Port Company
Syrian General Authority For Maritime Transport
Syrian Arab Airlines Company
General Organization Of Hijaz Railways
Cargo Transport Offices
Project For Reconstruction Of Hijaz Railways
LEGEND
DIRECT SUPERVISION
TECHNICAL & ADMINISTRATIVE SUPERVISION

FIGURE 2.1-1

- The MOT Training Directorate should be energized and staffed to:

  - develop a training program for the MOT and identify and arrange or conduct needed training for MOT personnel at the center and in the Mohafazat,

  - assume responsibility for training MOT personnel abroad,

  - review training programs of the individual transport agencies to assess their adequacy, to coordinate such training, to improve cross-utilization of training capabilities, and to identify needed multi-modal training that would justify a joint training course or facility,

- A qualified organization and management officer should be attached to the Deputy Minister of Transport for Administration to review and simplify the MOT's operations on a continuing basis.

- The postponed project to construct an office building for the MOT should be reactivated, or other action should be taken to obtain adequate office space that is as integrated as possible.

2.1.2 The Overall Organization Structure

This section describes and analyzes the organizational structure for transportation within the Government of the Syrian Arab Republic. The analysis deals with both the organization as it is formally defined in decrees, laws, and regulations - the de jure organization - and the organization it actually operates at present - the de facto organization. (The Consultants have obtained and translated into English the statements of organization and functions for all major transport agencies. These translations will be available to the Government for future use on completion of this study.)

The Central Government Agencies

Figure 2.1-2 shows, in schematic form, the Government organizations that are involved in transportation in relation to the other agencies of Government. In total, the Consultants have identified 9 ministries and 23 other organizations that are involved in transportation at the Central Government level. (This does not include organizations, such as the General Organization for Phosphates and Mines, that operate significant transport fleets in support of their primary purpose.) Of the 23 organizations other than ministries, 14 are general

GOVERNMENT ORGANIZATION FOR TRANSPORT

SYRIAN ARAB REPUBLIC

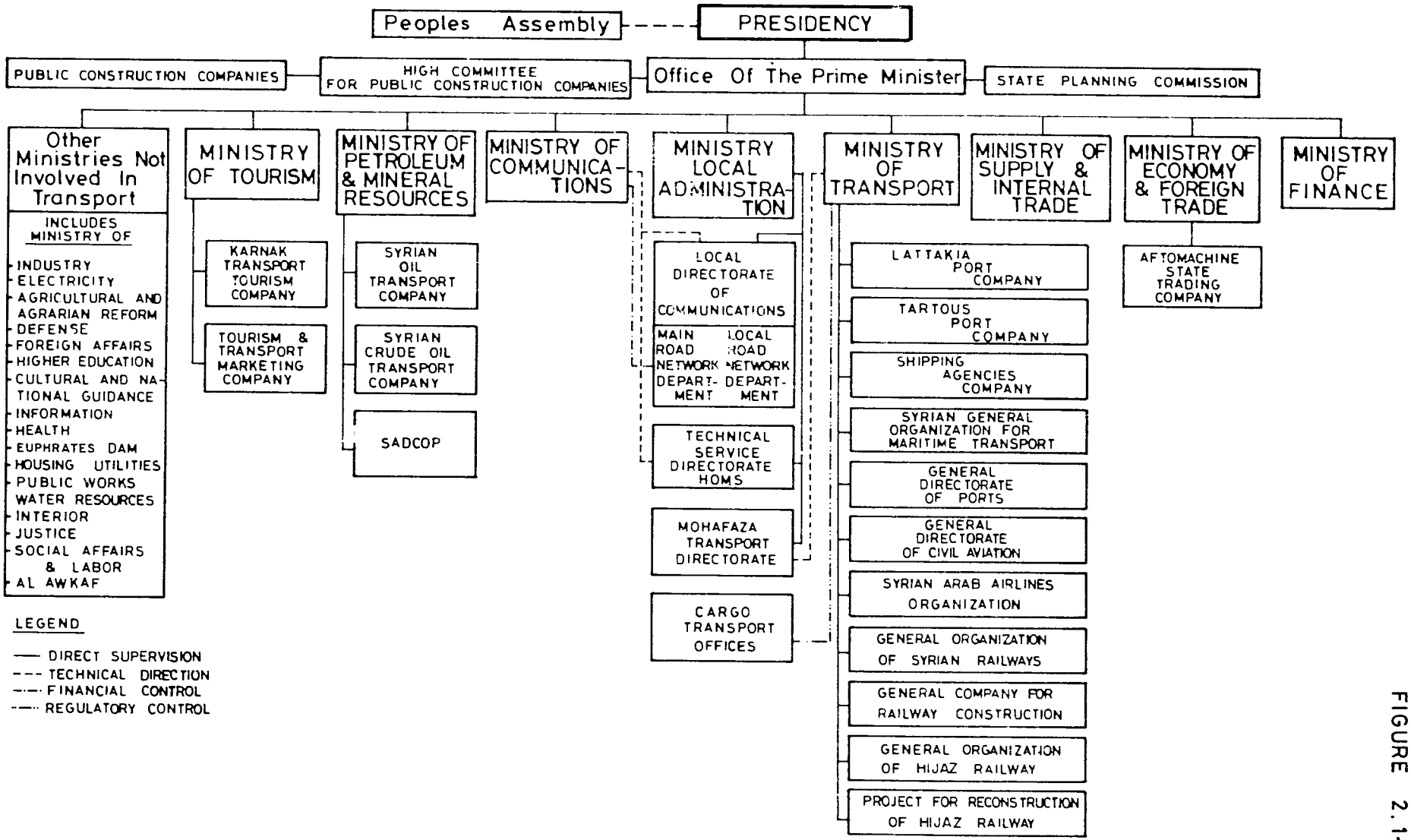


FIGURE 2.1-2

companies, and one, the Lattakia Port Company, is a mixed public/private company. The remainder are administrative subdivisions of the Government, such as the Director of Civil Aviation.

The nine ministries involved in transportation have significantly different involvements, in terms of both function and importance. The four ministries with primary responsibility for transport operations are:

- The Ministry of Transport (MOT), which was established in 1974 to develop, promote, and coordinate transport.

- The Ministry of Communications (MOC), which is responsible for all aspects, except major construction, of the primary road network and technical supervision of the secondary and tertiary networks.

- The Ministry of Local Administration, which oversees the Mohafaza governments in their roles as managers of the secondary and tertiary road networks.

- The Ministry of Petroleum and Mineral Resources, which supervises distribution of crude oil and petroleum products in-transit, for export, and internally.

The remaining ministries have varied responsibilities with regard to transport. The Ministry of Tourism supervises the Karnak Transport and Tourism Company, the major public intercity bus operator, and the newly established Tourism and Transport Marketing Company. (The Organization for Military Transport also provides public intercity bus transport.) The Ministry of Economy and Foreign Trade supervises the Aftomachine State Company, the primary importer of vehicles. The Ministry of Public Works and Water Resources supervises major port construction projects. (Railway construction is the responsibility of the General Company for Railway Construction.) The role of the Ministry of Supply and Internal Trade is regulatory. It is responsible for setting tariffs for various transport services.

The Ministry of Finance and the State Planning Commission, through the Five-Year Plans, the annual plans, and the annual budget, provide the primary formal mechanism for coordinating transport planning and development on a national basis.

The Local Government Agencies

There are 42 discrete transport agencies at the Mohafaza level. Twenty-eight are government organizations, with 14 Directorates of Transportation and 13 Directorates of Communications, one in each Mohafaza except Homs. In Homs, the Directorate of

Communications has been incorporated into the Technical Services Directorate, a Mohafaza-level multi-service organization that is being tested on a pilot basis. These 28 organizations are administrated by the Ministry of Local Administration but receive technical direction and supervision from the Ministries of Transport and Communications, respectively. The remaining 14 Mohafaza-level organizations are the Cargo Transport offices in each Mohafaza, which control the allocation of cargoes and movement of private trucks. These are private organizations that are closely regulated and controlled by the Ministry of Transport.

2.1.3 The Ministry of Transport

The Ministry of Transport was established on 1 June 1974 pursuant to Legislative Decree Number 93 to consolidate responsibility for all transport other than roads and pipelines. Functions were transferred from other ministries, primarily the Ministry of Communications, from which the basic personnel cadre also came.

Functions

The functions of the MOT as prescribed in Decree 93 are as follows:

- to develop and secure land, sea, and air transport of passengers and to organize and update transport consistent with the development and growth of the society, travel, and tourism activities in Syria,

- to develop and secure land, sea, and air transport of cargo and goods and to organize such transport consistent with the economic development in Syria and the expanding trade exchange and transit transport,

- to develop, promote, and raise the standard of the various means of transportation so as to meet the country's requirements, and to expand and strengthen the fleet of land, air, sea, and internal transportation,

- to coordinate work among the various departments, organizations, establishments, and companies undertaking transport activities and their relevant services, and to develop and integrate them, and

- to participate with the parties concerned in fixing transportation tariffs and charges and, in general, to handle all matters related to transportation and vehicles.

Subordinate Organizations

The following transport organizations are attached to the Ministry of Transport:

- General Organization of Syrian Railways
- General Organization of Hijaz Railways
- Project for Reconstruction of Hijaz Railways
- Lattakia Port Company
- Tartous Port Company
- Shipping Agencies Company
- Syrian General Authority for Maritime Transport
- Directorate General of Ports
- Directorate General of Civil Aviation
- Syrian Arab Airlines Company
- The General Company for Railway Construction

The Public Establishment for Internal Transport, the agency responsible for urban transportation, was abolished on 12 December 1979, and its responsibilities were assigned to the Ministry of Local Administration.

Overall Structure and Personnel

The organization structure of the MOT, as prescribed in the Minister of Transport's Decision Number 4 of 8 January 1979, is shown in Figure 2.1-3. (Discussion and analysis of the subordinate transport organizations are contained in the modal volumes of this report.) A brief description of the key organizational elements follows.

Any consideration of the MOT's organization must take into account the serious shortage of personnel. As of October 1979, only 16 percent of the Mouazafeen positions in the MOT were filled, and the number of personnel actually on board was only 17 percent of the authorization. The central administration was somewhat better off than the Mohafazat, with the deficit in the latter partly made up by loans of personnel from the center. Although not satisfactory, the situation in the central administration with regard to the supporting Mustakhdameen personnel is less serious: Fifty-five percent of the authorized positions are filled and the number actually on board is half of the authorization. However, even if one allows for the apparent over-authorization in the MOT, these personnel shortages are so severe as to be nearly crippling.

The Consultants have not identified any major backlogs of work in the classic sense of the term. There are no major cases of applications or correspondence that have been pending for a long period of time. There are specific instances where backlogs have occurred - if an office has only one professional, the work just stops if he or she is absent. But, in terms

MINISTRY OF TRANSPORT ORGANIZATIONAL STRUCTURE

SYRIAN ARAB REPUBLIC

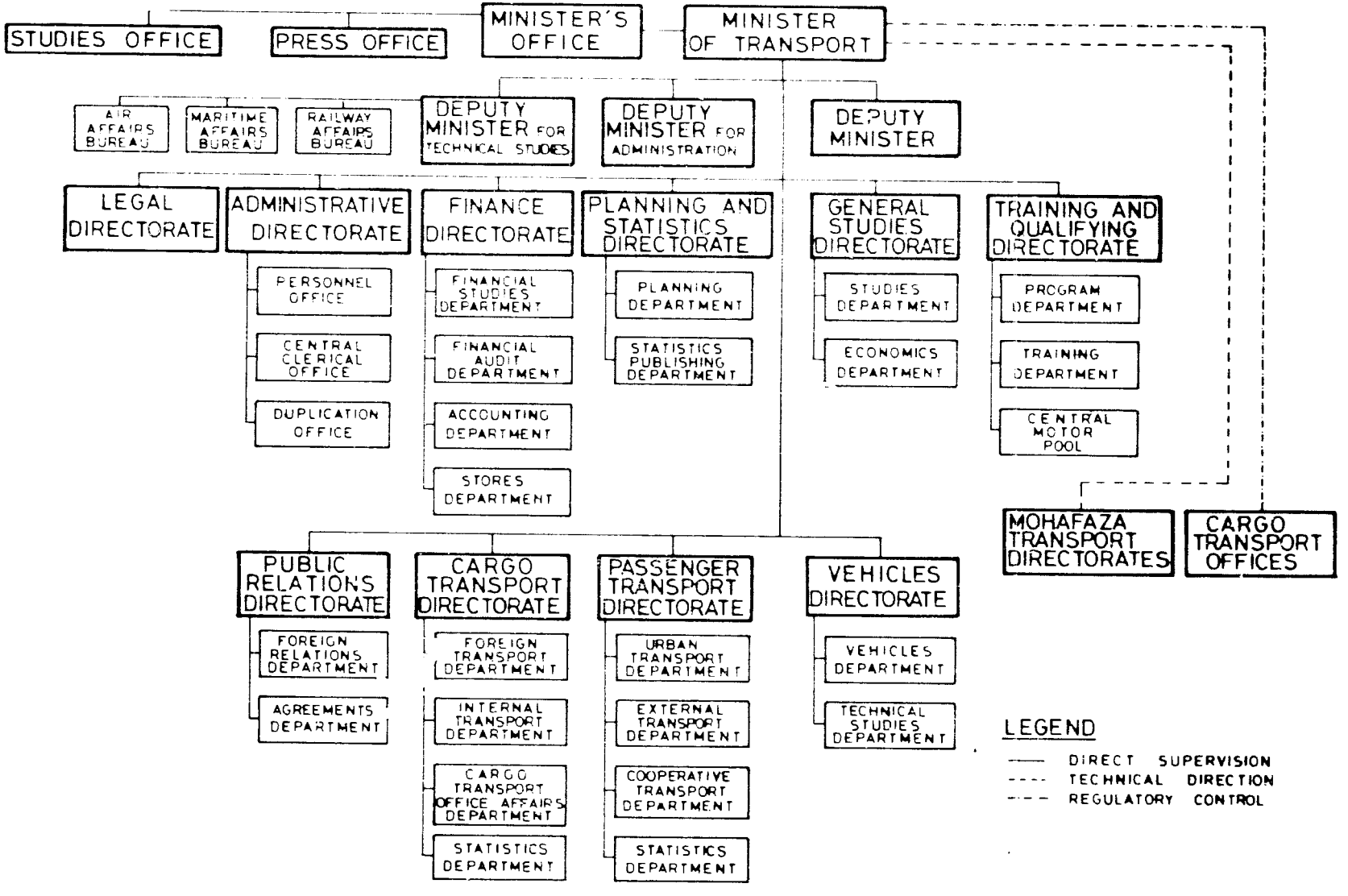


FIGURE 2.1-3

of work load, the shortage of staff appears to manifest itself in overtime and the limited amount of time that can be devoted to a given study or action. The Consultants have not reviewed overtime records, but they accept the statements that some key members of the staff of the Ministry work considerable voluntary overtime in order to keep the work moving. Nor is it necessary to review specific action documents to know that the present staff is not able to conduct the in-depth review and analysis that are required. This is apparent in any comparison of the Ministry's responsibilities and its staff. (See, for example, the sections on the General Studies and the Planning and Statistics Directorates that follow.)

The key responsibilities in the statement of basic functions of the MOT contained in Decree 93 are to "develop," "promote," "secure," and "coordinate" transport. Despite this statement, the basic organization of the Ministry is geared to regulation and control. The organization contains three principal operating directorates (out of a total of ten) and one that is quasi-operational. The three operating directorates (Cargo, Passenger, and Vehicles) contain 41 percent of the Ministry's personnel, and their current actual functions are almost exclusively regulatory. The quasi-operational directorate is the Public Relations Directorate, which is responsible for international transport agreements.

Key Organization Elements

The Bureaus: Every multi-modal transport agency faces the organizational problem of reconciling the handling of specific modal problems with the requirement to coordinate and integrate transportation, which is its raison d'etre. In response to this need, the MOT has created three liaison offices, called the Railway Affairs, Maritime Affairs, and Air Affairs Bureaus. The title bureau is somewhat grandiose, since two of these bureaus have one professional employee each and the Air Bureau has been a part-time responsibility for the Director of Administration. All three bureaus have two main functions:

- to serve as liaison offices and contact points within the Ministry and to follow up on actions concerning their mode, and

- to serve as staff arms to the Deputy Ministers on modal matters, primarily the preparation of necessary action documents and decrees.

The extent to which the staff function is performed varies among the bureaus and is limited by the paucity of staff.

Vehicles Directorate: The Vehicles Directorate is performing the major responsibility assigned it - technical direction of the Mohafaza Transport Directorates in the application of the vehicle registration law, including fees, and the application of technical standards for all vehicles in Syria. In addition, although not a formally assigned responsibility, the Directorate serves as a registration center for all diplomatic and Government-owned vehicles. This is a major workload, involving about 20 percent of the automobiles in Syria and occupying about 25 percent of the total staff of the Directorate.

Passenger Transport Directorate: The Passenger Transport Directorate is concerned exclusively with bus passenger transport. It is responsible for overseeing the Mohafaza Transport Committees in granting intra-Mohafaza bus routes, reviewing and approving inter-Mohafaza route allocations, and recommending international route assignments for the approval of the Minister. The Directorate participates with the Ministry of Supply and Internal Trade in setting inter- and intra-Mohafaza fares. It participates in studies of future requirements for bus imports. In addition, the Directorate directly supervises the establishment and operation of bus cooperatives throughout Syria. There are 80 such co-ops at present. (This function is ascribed to the Mohafaza Transport Directorates but is being performed centrally.)

Cargo Transport Directorate: Although the Cargo Transport Directorate has major assigned responsibilities for international transit transport and it is responsible for promoting transport of goods by rail, its principal preoccupation is the system of truck cargo allocations. The Directorate oversees the quasi-governmental Cargo Transport Offices in the Mohafazat, and it participates actively in the cargo assignment system. It issues standing orders for truck assignments and directs shifts from truck surplus Mohafazat to those with truck shortages.

Legal Directorate: The Legal Directorate is a single lawyer, assigned from the Ministry of Justice, who provides a general range of legal services to the MOT on matters such as draft laws, regulations, and decrees; contracts; and legal disputes.

Public Relations Directorate: This Directorate would be more appropriately named the International Relations Directorate. It is the central control point and the repository for international transport agreements including those regarding road transport. It coordinates participation by MOT personnel in international conferences and meetings, and the Director often serves as the Ministry's representative at such meetings.

Finance Directorate: The Finance Directorate handles the budgetary and accounting for ordinary, that is, operating, expenditures for the Ministry and the Mohafaza Transport Directorates. In the case of the latter, the Directorate reviews and consolidates the budget requests and allocates the funds that are appropriated. (MOT funding is only a portion of the funds available to the Mohafaza Directorates; the majority of their personnel and funds are provided through the Ministry of Local Administration.) The Directorate receives and forwards ordinary expenditure budgets of the subordinate transport agencies, such as the port companies, but it does not review or perform any substantive role with regard to them. Its sole responsibility is to obtain from the Ministry of Finance interpretations of an accounting nature - for example, whether or not a Port Director has the authority to sanction a particular gratuity for port employees. The Directorate has no responsibility for the investment budget, which is handled by the Directorate of Planning and Statistics. The Finance Directorate also orders, stores, controls, and issues the Ministry's supplies. (It is standard practice in the Syrian Government for this function to be located in the Finance Office rather than the Administrative Office of each organization. While it is a government-wide issue, the Consultants believe that better control would result if financial and physical control were separated.)

Training and Qualifying Directorate: This directorate exists in name only. Three of the Directorate's four employees are assigned elsewhere, and no training programs have been developed to date. (The MOT is currently building a driver training school at Adra to train Government and private students, and other schools are planned for Aleppo, Lattakia, and Homs.) The Directorate's stated functions include a full range of training program development and the conduct of training. However, its formal role with regard to subordinate transport agencies is limited to participation and does not include oversight of training programs or their coordination among the various agencies.

The General Studies and the Planning and Statistics Directorates: These two directorates provide the only present focus in the MOT for the integrated modal and inter-modal studies and analyses that are essential if the Ministry is to discharge its responsibilities to develop, promote, and coordinate transportation.

The General Studies Directorate is charged with conducting a wide range of analyses, including studies of:

- operating effectiveness,
- needed coordination,

- MOT operations,
- tariffs and revenues,
- transport bottlenecks, and
- requirements and availabilities.

The General Studies Directorate has no MOT professional personnel officially assigned to it. The Director is on loan from outside the Ministry, and the other two professionals on loan from Training do not have the background in economics or analysis that one would expect to find in such a directorate. As a result, the Directorate has not been able to conduct any of the types of studies assigned to it. The Directorate has been heavily involved in the design, awarding, and administration of the Consultants' contract. In addition, it has been occupied with ad hoc assignments, some of which are not within its formal functions. Nor is it likely that the Directorate can come near fulfilling its assigned role in the future with the presently limited availability of personnel.

The Planning and Statistics Directorate is somewhat better off in terms of personnel, but only relatively so. It is another example of the inadequate number of MOT personnel for the task at hand.

The Directorate is responsible for long- and short-range planning, including the annual investment budget for the transport sector, excluding roads and pipelines. Its responsibilities encompass the long- and short-range planning of the 11 major transport agencies subordinate to the MOT. The functions include issuing guidance, plan, and project review and approval and monitoring plan implementation. The Statistics Department, in addition to the collection and analysis of transport statistics, provides statistical guidance to other MOT elements.

The Directorate is formally charged with monitoring plan implementation, and it has formally been given responsibility for monitoring the continuing operations of the subordinate transport entities. This may be partly a result of personalities, but it appears to result primarily from the fact that there is no other logical place in the present MOT organization for this responsibility. The Directorate also handles training abroad, a function formally assigned to the General Studies Directorate.

Key Personnel

The Consultants are favorably impressed with the general level of personnel competence and energy of key MOT personnel. However, very few the personnel have training related to their present assignments. As of early 1979, there were only two

advanced degrees and only one degree in transport among the top 23 personnel. There were no key personnel with degrees in such relevant fields as economics, systems analysis, or business administration.

Office Space

There are no data in the MOT on area of office space per employee, but it is apparent that the current office space is so inadequate as to be a genuine impediment to effective work. To confirm this impression, one need only visit a typical office where a Director, his Deputy, and a secretary all work in a space so small that their desks abut each other. Indeed, space is at such a premium that it apparently has been a limiting factor in further employment. The Ministry had an approved project in 1976 to construct an office building, but the project was postponed because of a shortage of investment funds in that year, and it has not been reinstituted.

Management

Within the major limitation of the relevance of the overall MOT organization structure to the organization's primary purposes, and some over-organization, the Ministry's statement of functions, relationships, and lines of authority are generally clear.

Interrelationships among organizational elements are, in general, limited to those that are required because of unavoidable common interests. For example, both the Passenger Transport Directorate, which has primary responsibility, and the Planning and Statistics Directorate, which has a genuine programming interest, participated in a recent study on the requirements for the import of buses to meet forecast passenger traffic demand.

There are a number of procedures, primarily on administrative matters, where the Minister or Deputy Minister's approval is required on matters that do not appear to warrant attention at that level. The most common denominators appear to be:

- matters involving another Ministry,

- matters where there is no established system, such as with the Consultants' contract, and

- matters where special control has been imposed by a higher authority, for example, personnel appointments.

Despite these examples, the Consultants have also found that there is some delegation of authority within the MOT on matters that presently make up the main substantive parts of the

Ministry's business. These limitations on delegation of authority are not peculiar to the MOT or even to the transport sector. They appear to be an inherent part of the government system in Syria, and there is little that the Consultants can say about them beyond the fact that over-centralization is inhibiting efficient operations. However, there is no real delegation of authority on matters dealing with the subordinate transport agencies.

2.1.4 Planning

Overall Organization

Primary responsibility for national planning is vested in the Supreme Planning Council. The Council is chaired by the Prime Minister. The Supreme Planning Council is responsible for:

- defining plan objectives,

- providing guide figures for annual, medium, and long-term plans,

- recommending annual, medium-term, and long-term plans to the Council of Ministers,

- coordinating between plan sections, overall plan balance, and optimum utilization of productive capacity, and

- supervising plan implementation and directing actions to improve it.

In the execution of these functions, "The Council may issue all decisions on cases and matters within its competence with respect to preparing and executing plans. Such decisions shall be binding upon all government and economic bodies."

The State Planning Commission (SPC) is the "technical organ for the Supreme Planning Council to enable it to perform its functions in terms of State planning policy, and supervising its implementation in the economic and social sectors." As such, its functions are extensive and comprehensive. They include: planning methodology; plan preparation; supervision of implementation; concluding external agreements for economic, scientific, and technical cooperation; and, with the Ministry of Finance, estimating external and public sector revenues and foreign exchange.

Within the SPC, the Transport, Communications, and Storage Directorate has eight professional personnel, one engineer and seven economists, one of whom works solely on telecommunications.

The budget procedure, which coordinates with and supports the planning process, was described in Volume VII, Chapter 2, Section 2.1.6 of the Final Phase I Report.

2.1.5 Changes in Overall Organization

General

The responsibilities of the MOT, as set forth in Legislative Decree 93, are very broad. They encompass land, sea, and air transport without qualification or limitation. They include responsibility to "develop," "secure," "promote," and "strengthen" such transport and require the MOT "to coordinate work among the various departments, organizations, establishments, and companies undertaking transport activities and their relevant services, and to develop them and realize integration among them." (While the term supervise does not appear specifically in the MOT's statement of responsibilities, the Consultants consider that it is inherent in them. Taken together, the responsibilities can only be discharged if the Minister supervises and directs the subordinate transport agencies that are attached to him. This is assumed in the discussion that follows.)

Although there are a large number of ministries and agencies involved in the transport sector, the Consultants have not identified problems that would justify either a major reorganization of the sector, the creation of a single overall transport ministry, or the creation of a new coordinating council or other mechanism above the ministerial level.

Some changes are needed in assignment of responsibility and in procedural improvements. They fall principally into five areas:

- planning, including manpower planning,
- the national transport data bank,
- road construction and maintenance,
- tariffs, and
- vehicle operating costs.

Planning

The Consultants recommend that the Supreme Planning Council and its supporting arm, the SPC, remain the only point in the Government where full inter-modal transport planning occurs. They have adequate authority to perform the vital role, and the number of persons with suitable training for this complex task is limited. This responsibility should not be dispersed between two Government organizations both of which have a responsibility for sector-wide transport planning.

Planning of the transport sector in Syria has been less sophisticated than is desirable The problem is not basically an organizational one, although manpower limitations certainly play a part. The basic problem is lack of data and the tools to use them.

The Consultants suggest that the next step in the development of transport planning within the Syrian Government be to implement the type of demand-oriented planning used to develop this report. The main tools and approaches in the system are incorporated into SYRTRANS, an integrated computer transport planning model. The model and its components are described in Chapter 1 of this volume.

The Consultants believe that this planning system will provide a sound basis for transport planning through 1985 and for forecast requirements to the year 2000. But the system is perishable. If it is not maintained and updated (by, for example, creating new zones as demand changes), it will soon be of little value. This will also happen if the basic input data, such as traffic counts and road inventory, are not kept current.

Manpower Planning in the Transport Sector

The Need

A critical factor in the orderly planning and long-range development of the transport sector is conducting a manpower requirements study to define skill needs versus availability to the year 2000. The Consultants have projected transport demand to that year but a parallel manpower study is beyond the scope of present work. Such a study is necessary, however, to permit long-range planning of the training programs needed to develop skills found to be in short supply.

The Manpower Planning and Higher and Technical Education Directorate of the SPC has recently completed one phase of its nationwide manpower survey. This survey will provide manpower inputs to the next five-year development plan.

The Directorate has identified the number of employees on the payroll and the skill needs of each organizational entity, including those in the transport sector, as of 1978. They are listed by occupational code and by level of education. In addition, the survey obtained data on forecast 1980 year-end manpower needs for these organizations. Attrition was taken into account in this projection. The occupational codes used were basically the International Labor Organization's "International Standards for Occupational Classifications" (ISCO) with some modifications.

The survey can be used to provide the baseline data for future projections of transport sector manpower needs. The ISCO codes, however, will likely be too general for many unique transport skills and sub-codes may need to be developed.

The Manpower Study

It is recommended that a manpower study be undertaken to identify present critical skill shortages in the transport sector and to forecast future demand for these skills. Ideally, such a forecast would be to the year 2000 since the Consultants' SYRTDA model projects transport demand to that year.

It would be desirable to hire a manpower planning expert under a technical assistance program to assist in this work. At least one year would be required.

Suggested terms of reference for this study follow.

- Review results of the recently completed manpower survey by the SPC's Manpower Planning and Higher and Technical Education Directorate to determine the applicability of existing transport sector manpower data as a base line for projected future needs.

- Determine whether the classification system used by SPC for defining skill levels can be used for defining the detailed skills applicable to the transport sector (e.g., stevedores, traffic dispatchers, diesel locomotive mechanics). If not applicable, expand the classification system as necessary, using the U.S. Department of Labor's Dictionary of Occupational titles as a guide, if appropriate.

- Set up a plan for using existing manpower data (needs versus supply) where available, and gather additional data if gaps are found.

- Establish base-line 1980 manpower requirements versus supply for each organizational entity in the transport sector and collate the data for the sector. These requirements should be based on the skill classifications determined in the second task.

- Project these manpower requirements initially for the next five years based on each organization's expansion plans to coincide with the five-year development plan, and then to the year 2000, to coincide with the Consultant's long-range projections of transport demand. Develop an appropriate forecasting technique for these projections and identify the error range of the projections.

- Assign priorities to identified critical skill shortages and recommend actions to be taken to alleviate them.

- Investigate skill mobility as an integral part of the study.

- Prepare a detailed report on overall results.

The National Transport Data Bank

The present division of responsibility for transport bears directly on the question of where a national transport data bank, the associated programs, and the present mini-computer should be located. The data bank will serve two basic purposes, and while each purpose has some unique data requirements, there is a broad overlap between them. The purposes are:

- to support transportation planning, and

- to provide information essential for effective management of transport operations at the Central Government level.

Any organizational location will involve some compromise between these purposes, and their relative importance and timing are factors to be considered. Since the data bank is initially to be primarily a planning tool, the logical location would be in the SPC. Because of its location in the Government and its strong statutory authority, the SPC would be in a position to obtain the data inputs that must be provided by the several ministries involved. Moreover, the SPC, is the only place in the Government where true multi-modal transport planning can take place. An added advantage would be that in the SPC the transport data bank could potentially serve as a nuclear component of a broader national multi-sector data bank and planning system.

The major disadvantage of locating the data bank in the SPC is its remoteness from current operations. Data needed for planning are not as frequent or as timely as they are for operations, and there is some question as to whether the SPC, not being directly involved in operations management, would be seized with the need to collect and supply timely operational data or to create the programs to use it effectively.

If the primary purpose of the data bank is to support effective management of transport operations, the data bank should be located in one of the several operating ministries. Because the MOT has by far the major responsibility for transport operations, it would be the logical choice. The major advan-

tages here would be location of the system at the point where central operational management must take place, thus ensuring ready availability of needed information and analyses and providing the motivation for timely data collection and production. It might also give impetus to the MOT to move toward a stronger role in overseeing the operations of its subordinate agencies. Most of the data required by the SPC for planning would be a natural product of the operating data. The major disadvantage is the question of whether the MOT is organizationally in a position to obtain necessary data inputs from the other co-equal ministries, especially the Ministry of Communications. This is potentially a serious problem. MOC systems for collecting and maintaining critical data such as traffic counts and road inventories have broken down in the past, and special effort will be needed to continue the programs undertaken by the Consultants in the course of this study.

For several years immediately following the conclusion of the present study, transport planning is almost certain to be the dominant reason for having a national transport data bank. The body of programs that will have been developed are those that comprise SYRTRANS - a multi-modal transport planning model; and the contents of the data bank at that stage will be the data collected for use in the model. Moreover, as discussed below, the MOT is not currently organized or staffed to supervise the operations of the subordinate transport agencies. Under foreseeable circumstances, it would be some time before the MOT could fully utilize a data bank for operational management, even if the data and programs were in place.

For these reasons, the Consultants recommend that the national transport data bank, the Zilog mini-computer, and the SYRTRANS program be placed in the Transport, Communications, and Storage Directorate of the SPC at the completion of the study. However, it must be emphasized that this is an initial step and that over the longer term an either/or decision is not mandatory. The cost of a mini-computer system is minor in the context of the total transport sector costs in Syria. A logical progression would be to place the present computer and the data bank in the SPC, with the MOT acquiring its own systems soon thereafter. The latter could collect required data, analyze and use it for more operational purposes, and supply information in approximate form to the SPC for planning use.

Road Construction and Maintenance

The present division of responsibility for road construction and maintenance between the MOC and the Ministry of Local Administration precludes effective road planning and is resulting in substandard construction and maintenance work.

This is discussed in detail in Volume IV, Chapter 3, and alternative solutions are analyzed in Chapter 2 of the same volume. Based on that analysis, the Consultants have recommended that responsibility for all roads be reconsolidated in the MOC, which would directly supervise the Directorates of Communications in the Mohafazat. Participation of local administration authorities would be provided for in the budget and planning review processes.

Transport Tariffs

Tariffs are a critical element of effective transport management. As is pointed out in Chapters 3 and 4 below, nationalization of rail and road passenger and freight tariffs is essential if Syria is to achieve the utilization of its expanding rail infrastructure that would provide the greatest economic benefit to the country.

Despite the importance of tariffs, the MOT's role with regard to them is ambiguous and its organizational capability is weak. Decree 93 states only that the MOT is "to participate with the parties concerned in fixing transportation tariffs and charges," and there is no formal mechanism established by which it can do so. The truck tariff increase promulgated in October 1979 was under study for five years. It was first proposed in late 1975 by the MOT, and the final proposal was made by an ad hoc inter-ministerial working group after conducting several interim studies. Similarly, an increase in passenger tariffs proposed to the Ministry of Supply and Internal Trade in March 1979 had not been acted on seven months later. The MOT's responsibilities with regard to tariffs need to be made specific, and a mechanism must be created to provide for adequate consideration of the competing factors and competing ministry interests involved in setting tariffs and ensure that they are regularly reviewed and updated. If this is to be done, however, the MOT will need to be organized and staffed to discharge its assigned responsibilities, and the present fragmented responsibility for tariffs within the MOT will have to be consolidated.

Therefore, the Consultants recommend that primary responsibility for recommending road, rail, and air passenger and freight tariffs be assigned to the MOT. The Ministry should formally chair a committee which includes representatives from all government agencies. Within the MOT, the responsibility should be assigned to the proposed General Studies and Tariffs Directorate. One professional staff member, preferably with specialized training abroad, supported by sufficient clerical staff, would be required.

2.1.6 Organization of the Ministry of Transport

The Organization Structure

The MOT is over-organized, with 10 directorates and 42 separate organizational elements and an onboard professional staff of 71. The span of control, before considering the operating agencies (10 directorates and 3 deputies) for the Minister is too large, although this is not as significant as the problems of control that result from the separate subordinate transport agencies that report directly to the Minister. The span within the Ministry itself can be reduced by combining some directorates, although the Consultants recognize that under the present government system, this might reduce promotion opportunities for present and future personnel.

However, the relationship between the subordinate agencies and the MOT goes to the heart of its major organizational problem - the fact that it is not now organized to effectively discharge its primary responsibilities. These responsibilities require that the MOT be organized:

- to review and analyze the long-range and annual investment plans, programs, and projects of its subordinate transport agencies and to monitor their implementation,

- to play a lead role in determining passenger and freight tariffs,

- to conduct independent modal and cross-modal studies of both programming and operational natures, and

- to supervise and coordinate the operation of the subordinate agencies.

Organizationally, the first three functions would be adequately provided for through the Planning and Statistics Directorate and a strengthened General Studies Directorate. It is the last function that is the major gap in the Ministry's organization. The Minister cannot supervise and coordinate the operations of 12 separate subordinate transport agencies without adequate staff support. Nor can the three bureaus (the liaison offices) perform this function. They may provide a needed contact point in the Ministry for their client agencies, but they are more representatives of the agencies than independent overseers serving the Minister.

The operational management functions could be assigned to separate modal operations directorates or to a single operations directorate combining all modes. A single directorate would lessen the span of control of the Minister and improve

the capability for cross-modal coordination, but it would probably have to be organized internally into modal departments. The major disadvantage of a single directorate would be the concentration of responsibility that it would represent.

The advantages and disadvantages of separate modal operations directorates are the reverse of a single one. While several directorates would increase the span of control within the Ministry proper, this would tend to be offset by the reduction in the effective span of control over the subordinate agencies. Additionally, the presence of a strong General Studies and Tariffs Directorate to examine major inter-modal operational problems would provide staff assistance for the required inter-modal coordination at the Deputy Minister and Minister level.

The present line directorates dealing with cargo and passenger transport should be consolidated in this process. The Vehicles Directorate is performing operational functions which would be better placed below the Ministry level. The Consultants recommend that this directorate be reestablished as a General Directorate for Motor Vehicles, analagous to the Directorate General of Civil Aviation. Its functions would include driver training.

The Consultants have tentatively identified the following functions that could be assigned to each of the modal operations directorates.

The directorate would serve as a staff arm to the Minister of Transport and, where authorized, act in his behalf:

- to review and analyze the annual operating and financial plans of its subordinate agencies for conformity with national and transport policy; for internal consistency and practicality; for adequacy of production targets; and in coordination with the other operating directorates, for potential inter-modal problems,

- to monitor agency performance against approved operating and financial plans and production targets, to determine causes of over- and under-performance, to propose solutions for identified problems, and to recommend problem areas requiring further in-depth study,

- to participate in review of tariffs in its mode,

- to review proposed construction of facilities and procurement of equipment from the standpoint of operating effectiveness, and to make appropriate recommendations to the Planning and Statistics Directorate,

- to assist and represent the subordinate agencies on matters that require action at the Central Government level,

- to serve as a contact point in the MOT for modal matters, and

- to participate in the preparation of regulations appropriate to its mode and to conduct appropriate regulatory activities.

The Consultants have recommended above that the present SYR-TRANS model and national transport data bank be placed in the SPC. However, the recommendation notes that the MOT will need to develop an independent computer capability. That capability should ultimately serve all elements of the organization and functions ranging from planning to payroll. The type of computer used in this study would be adequate for the immediate future, and organizational provisions should be made for it.

Whatever organizational solution is adopted, its effectiveness will depend on the extent to which real authority and responsibility are delegated. If there is no delegation beyond what presently exists, a directorate or directorates can usefully serve as a staff arm to the Minister, providing him with independent advice on operational problems that will improve his ability to supervise the subordinate agencies. But, without real delegation, the involvement of the staff will be limited to matters of ministerial interest, and lesser, but important, matters will not be effectively dealt with.

Based on the above considerations, the Consultants have prepared the recommended alternative organization for the Ministry of Transport shown in Figure 2.1-3. To further delegate authority and to releive the burdens on the Ministry, the recommended organization groups the functions of the Ministry under three line Deputy Ministers:

- a Deputy Minister for operations,
- a Deputy Minister for Plans and Studies, and
- a Deputy Minister for Administration and Training.

Personnel

Additional staff is a prerequisite to other actions to improve the effectiveness of the MOT. Training programs require personnel both to be trained and to conduct the training, and there is little point in creating new organizational arrangements that merely stretch a limited staff even thinner. While the problem is particularly acute in the MOT, it is common throughout the transport organization of the public sector.

Employee morale and productivity are low, and a few people carry a disproportionate share of the load. Despite laws to the contrary, many employees hold second jobs outside the Government, and in some places older, competent staff members function with no replacement in sight. As they retire, the crisis will worsen.

The problem of Government salaries is generally recognized in Syria, and it is not within the scope of the Consultants' work to recommend substantial changes in the overall salary schedules for Government employees. Nor is it evident that across-the-board increases will solve the problems. However, the transport operating agencies are economic enterprises. Within broad limits, salary systems and salary increases that contribute directly to improved productivity would be more than offset by the financial and economic returns that would result.

The Consultants can only state clearly their conclusions that the salary problems must be solved and that increased qualified professional staff are essential to achieve effective performance of the MOT. The Consultants recommend that the Government review possible means to obtain the needed personnel.

2.2 TRAINING

2.2.1 Introduction

The Consultants have noted that in-service and some formal training is required at all levels within the MOT and in its subordinate establishments.

The existing situation within MOT as regards training and human resources development is critical. (Human resources development is defined as all of the factors involved in adapting an employee to a specified position. These include manpower planning, selection, hiring, orientation to the job, training to meet job requirements, and career development.) There is no central planning for human resources development, no coordination capability, and little actual training capability except in the civil aviation subsector.

A training department or section exists, usually in name only, on the organization charts of the major agencies. This function is seldom staffed, however. Even the MOT's Training and Qualifying Directorate is not staffed, except for the Acting Director, whose sole work to date has been helping to set up driver training schools.

The fact that the MOT is a relatively new ministry is probably one reason for the lack of attention paid to training. It is now timely, however, for the Minister of Transport and his

senior staff to provide backing to the development of training capability throughout the entire organization. Such development must start at the top of the organization and must be fully backed by top management in terms of establishing policy, developing plans and guidelines, providing a budget, and periodically evaluating results. If this is not done, the MOT training function will continue to be ineffective.

This means immediate activation of the Training Department in the recommended Training and Personnel Directorate. As proposed, the charter of responsibilities of this department should also be broadened to include coordination, guidance, and some control of subsidiary establishment training. In addition, the MOT should require that the training fuction in each of its individual establishments be activated, that qualified training managers be hired where necessary, and that they begin to identify critical training needs and assign priorities to them. The Consultants' reports in the modal volumes should provide the basis for doing this.

2.2.2 Relevant Basic Principles in Development of a Training Capability

Training should make a positive contribution to meeting the basic objectives of the organization and should be evaluated on the basis of how well it does this.

Operating Establishments: In these establishments, productivity is generally the primary objective. Training programs must therefore be planned to help improve productivity. How well they do this can be measured through cost/benefit analyses and results can be shown in terms of cost savings.

Ministry Level: In the ministries, training is required primarily at the management and supervisory levels. This type of training (e.g., in management practices, communications, planning) is more difficult to measure in terms of results. Training in these areas should therefore be thought of primarily as an investment in human resources that results in improving the skills of the staff and increasing its potential, and hence contributing toward overall MOT objectives.

A second basic priciple of an effective long-range training program is that it should start at the top of each organizational entity. Senior managers who take short courses or seminars in management by objective, for example, will be encouraged to carefully examine, or perhaps even redefine, that entity's goals and objectives. They will also better understand how these goals and objectives can be translated into both

strategic (long range) and tactical or operational plans. Implementation of such plans requires evaluation of the organization's manpower capability and needs. This action in turn leads to definition of specific training needs to meet specific objectives. Top management must understand and endorse this process.

Management must believe in the need for such objective-oriented training and must recognize that it generally pays for itself in terms of higher productivity and performance. Otherwise, it will be neglected or considered something good to have if it can be afforded but the first to be dropped if the budget is limited.

The third major principle which transport sector training must observe is that it requires both long-range (five years) and short-range (one year) planning. Such planning must involve the line managers in the organization. They are the experts in their own manpower needs. They should become actively involved with the training staff in developing plans and programs for their own areas based on these needs. These plans should include how to institutionalize the training function so that it becomes a continuing operation.

Training programs are generally most effective when the joint planning process noted above is jointly carried into implementation.

Since all departments in an organizational entity conduct on-the-job training, either casually or by design, the extension of this to coordinated training programs where the department manager or qualified staff member participates actively with the training staff is usually most effective. This approach to training is currently being used by Syrianair. The department manager involved in a specific program is given the necessary incentive to plan and even conduct courses by being paid extra. This approach benefits both the operating departments - which receive improved training - and the training staff - which can be kept small and can concentrate on developing improved teaching techniques, syllabi, and teaching aids.

A fourth major principle upon which MOT's future training plans and actions should be based is that an evaluation system must be built in to the overall program at its start. This evaluation system should be designed to measure how well the program does in fact meet stated objectives. When an objective is increased productivity, the change in output of the trainee can be measured. If, in actual practice, the trainees, for any reason, are unable to apply what they have learned to their actual job in that job's environment, the validity of such training must be questioned. Continued feedback from the line departments to the training department is therefore essential.

Finally, a manpower requirements study should be an integral part of any long-range training program.

2.2.3 MOT-Training and Personnel Directorate - Training Department

The functions of the present Training and Qualifying Directorate are not broad enough to fulfill the MOT's basic responsibility: "to coordinate work among the various ministerial departments and subsidiary establishments." In particular, planning, monitoring, and coordination of training within the MOT's subordinate establishments is mandatory if the Ministry is to develop its human resources effectively and use its limited physical resources most efficiently.

There is therefore a serious need to strengthen the Training Department in MOT and provide it with the capability to develop policy and training guidelines, to plan, to coordinate, and to prepare training programs jointly with these various establishments.

Investment in training must be done wisely. Duplication of effort, facilities, and resources must be avoided and common programs developed where feasible. The MOT's Training Department should have the responsibility for developing training policy and guidelines and for monitoring all training done in its subordinate establishments to insure that it meets prescribed standards and makes efficient use of existing training resources. Recommended functions to meet these objectives are set forth in section 2.1 above.

If the Training Department is to perform the proposed functions effectively, it must also be properly staffed. The Ministry should seek a Director who either has broad experience in training program planning and transport sector activities, or who has support of an adequate staff.

2.2.4 Advisory Services

It is recommended that an expert training advisor be obtained through an appropriate technical assistance program to work directly in the MOT's Training Department with the Department Director. The responsibilities of this advisor will be supporting the Director in preparing his staffing requirements; training the new staff as required; planning and then undertaking the tasks necessary to meet the proposed new responsibilities of the Training Department and then working with the training directors and advisors in the various subordinate establishments to develop their own plans and programs. He

could make an important contribution to the development of detailed terms of reference for the advisory and training services recommended in other volumes of this report.

2.2.5 Training Development and Coordination

The considerable expansion of training capability inherent in the Consultants' proposals for technical assistance in training in the various establishments will require close coordination and top ministerial support if this effort is to be productive. To assist the MOT in insuring that such technical assistance work is used effectively and that duplication of efforts is avoided, it is proposed that a training committee be organized, chaired by the Training Director of the MOT. Committee members would be the training directors in the various modal organizations. Technical assistance advisors in any MOT establishment would be ex-officio members. This committee should have the following functions:

- Establishing a line of communication (non-existent at present) among the organizations that are responsible for training.

- Acting as a panel to review transport sector training policies, needs, programs, and priorities, as developed by the various establishments.

- Reviewing recommendations and plans for training programs for which the Consultants have proposed advisory services.

- Determining where training programs can be combined to make most efficient use of personnel training facilities and resources.

- Helping to establish guidelines for development of training plans and programs and justification of training budgets.

- Serving as a review panel for transport sector personnel proposed for additional training abroad and then providing support in getting approval for such training.

- Developing guidelines for evaluation of training programs for reporting on programs and for conducting manpower requirement analyses.

- Conducting a survey of existing training facilities, equipment, and courses within the various transport organizations of the MOT. Contacting relevant training organizations in other ministries to determine capabilities and possibilities of sharing talent and facilities.

In addition to this committee, it is also necessary to have a single point of contact and coordination at the highest possible level in the transport sector. This means that the Directorate of Transport Communications and Storage in the SPC should be directly involved in planning for the recommended training and advisory services. This directorate should be supported technically by the Manpower and Higher and Technical Education Directorate.

Key areas of concern at SPC should be:

- insuring that any advisory services that are proposed make most effective use of existing professional staff within the organizations involved,

- insuring that existing facilities and other teaching resources such as the various vocational training centers and the Management and Productivity Center are used when appropriate,

- providing guidelines for long-range training plans,

- developing procedures jointly with the Manpower Directorate for periodic projections of transport sector manpower requirements,

- insuring that transport sector training is made an integral part of the transport sector five-year development plans,

- holding periodic seminars on transport sector planning and the role of human resource development in that activity,

- providing guidelines for professional and continuing evaluation of all training done in the transport sector, and

- providing support to the MOT and MOC in obtaining proper professional staffing of their training directorates.

2.2.6 Proposed Immediate Training Programs

The fact that training and its positive impact on productivity and human capital development must be understood and backed by top management has been continually stressed throughout this report. Furthermore, the need for management training in such areas as management by objectives, communication skills, and program planning has been noted.

The Consultants believe that a series of management workshops conducted for transport sector organizations would result in both a better appreciation of what proper training can do in terms of job effectiveness and improvement of the management

capabilities of these organizations. A major important by-product would be increased communication among departments and directorates.

The Management and Productivity Center of the Ministry of Industry, which was set up and is currently operating with support from the UNDP, develops and conducts such programs. It recently finished a workshop in Performance Improvement Programming (PIP) for top managers of several public companies in the Ministry of Industry. The managers from each company worked together as a team on problems directly related to the company's goals and objectives.

Such a series of workshops could be readily adopted to the transport sector. The topic is most relevant and could be applied to ports, railways, construction companies, the MOC, and the MOT. In fact, the Management and Productivity Center can send teams to Lattakia, for example, to give such a workshop to one or both ports.

It is recommended that the Directorate of Transport, Communications, and Storage in the SPC sponsor a pilot transport sector workshop in Damascus. This first workshop should be attended by all directors in the MOT and MOC. After evaluation of the workshop's effectiveness, plans should be made to give it in transport sector operating organizations.

Workshop hours are generally arranged to suit the majority of attendees and the series spread out over time so that these busy senior officials will not have their work interfered with too much.

In addition to adapting the course to the transport sector and giving periodic workshops, it is also recommended that the Management and Productivity Center develop a special program for training and trainers. Almost each establishment in the transport sector has a training director or manager shown on its organization chart. In some cases this position is filled by personnel with some experience or education in training; but in many cases the position is vacant. This latter situation is indicative of the relatively low importance placed on training by that establishment.

The Consultants, however, have placed considerable emphasis on training combined with appropriate advisory services in this report. The importance of having well-qualified training managers on the staffs of all of the major transport sector establishments cannot be overstated. The long-range success of the proposed advisory services ultimately rests on them.

These key training managers or directors should be chosen on the basis of specific job descriptions. In many cases, however, because of the unavailability of qualified personnel,

the training manager may have good practical operating experience in the particular transport mode but little if any experience or education in managing training programs. This gap in knowledge should ideally be filled by a combination of some training abroad in the theory, principles, and techniques of modern training, plus in-country applied courses.

The Management and Productivity Center has the capability to develop and conduct such programs adapted to the actual environment in the Syrian transport sector organization.

Such a program should include at least the following:

- the role of manpower planning,

- long-range training needs analyses and short-term task analyses,

- developing a long-range training plan,

- costs versus benefits of training programs,

- preparing specific training objectives based on analyses of needs,

- principles of training-program (including syllabus) preparation and choice of method of teaching (case studies, role playing, management games, workshops, etc.),

- principles of teaching, learning, and individual differences,

- training program evaluation techniques, and

- developing and defending a training budget based on the program's contribution to productivity.

2.2.7 Transport-Related Education at Syrian Universities

At present, little applied engineering or economics relevant to the transport sector is taught in Syrian universities. In particular, gaps exist in the following areas:

- transport system economics and feasibilty studies,

- transport system technical planning,

- systems analysis and computer modelling of transport modes, and

- applied road and bridge design.

A number of courses are given in a few specific areas, such as traffic counting, analysis and interpretation, and origin and destination surveys. However, courses are not brought together so that the student can understand the overall integrated transport system.

It is recommended that the Directorate of Transport, Communications, and Storage begin discussions with the University of Damascus to develop a joint plan to begin to add a few key courses in transport sector areas in the School of Engineering (Public Works and Communication Department). The first basic course recommended to be added is one, in transport systems analysis and modelling. The Consultants' SYRTRANS model could be used as a practical example of how computer modelling can be applied to specific transport sector problems.

In addition, it has been noted in Volume IV that road and bridge design engineers do not have the practical knowledge required to actually perform this work. Strengthening such courses could benefit the transport sector greatly. Sound practical or applied work, coupled with the necessary basic theory, would help make the new engineering graduates more prepared to work in the environment they will enter upon leaving school.

2.2.8 Summary of Training Requirments

In this volume and the modal volumes, the Consultants have recommended an interrelated sectoral manpower and training program to meet identified skill shortages and management needs. The program includes:

- a detailed manpower study for the sector,

- overall coordination of training by the Directorate of Transport, Communications, and Storage in the State Planning Commission,

- improved planning and direction of training by the Ministries of Transport and Communications,

- upgrading of functions and staff in the training offices of the various modal agencies,

- establishment of a training coordinating committee in the Ministry of Transport, and

- specific training and advisory services.

The recommended specific training and advisory services, together with the estimated man-months and range of costs, are summarized below. The information in parentheses refers to the volume and section containing a more detailed discussion of each.

Summary of Services	Estimated Man-Months	Cost Range (SP 000)
1. Training advisor to assist the Ministry of Transport in developing an effective training department and training plans and programs within the Ministry and its subordinate agencies (VII, 2.2.4).	24	200-266
2. Workshops by the Management and Productivity Center of the Ministry of Industries on performance improvement programming, and transport training and trainers. (VII, 2.2.6)		a
3. A manpower planning expert to assist the SPC in a sector manpower study (VII, 2.1.5).	12	10-13
4. A Syrian computer expert to advise and assist in training Government staff to operate SYRTRANS and the Data Bank (VII, 1.4.2).	24	140-190
5. A wide-ranging advisory assistance and training program in railway operations and management (III, A-1.5).	360	12,000-15,000
6. A training and advisory program to develop a road maintenance training and production unit in a selected Mohafaza (IV, 2.3).	150	1,250-1,660[b]
7. A road and bridge design and construction expert to review design standards and train Ministry of Communications staff (IV, 2.3).	12	110-145

8. Training of selected port officials through observation tours abroad (V, A-5.13).	8	137-155[c]
9. An advisory training team to develop an on-the-job training program and improve operations at Tartous and Lattakia ports (V, A-5.13).	215	1,800-2,400
10. An aviation training expert to assist the Director of Training of Syrianair to improve the airline's training program (VI, B-6).	-	8-10
Total	805	15,655-19,840

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[a] Costs not available.

[b] Excludes maintenance expert.

[c] Does not include officials' salaries.

2.3 SOURCES OF FUNDS

Government Budget and Revenues

Introduction

The Consultants' attempt to assess sources of funds available for transport was restricted by the limited availability of historical data. The Consultants requested budgeted and actual expenditures by category and by specific budget account title and number but were advised that the requested data were not available. The Consultants also requested information on foreign economic assistance in total and for the transport sector and were advised that the data could not be released.

As a result, the Consultants undertook to compile historical data on transport revenues and expenditures from a variety of sources, including IMF and World Bank reports and accounting reports of individual transport agencies. This effort was

hampered by the fact that the accounting reports of many transport agencies are two years or more behind schedule. In such cases, the Consultants prepared the best estimates using budgetary and collateral data.

Based on these historical data, the basic forecasting methodology was to project the overall Government budget, and based on the relationship between the transport sector and the Government budget as a whole, to derive the estimated development budget and expenditures for the transport sector. The calculations were made in current prices and then adjusted for inflation. These historic budget data and the underlying details of the forecast were presented in Volume VII, Chapter 2, Section 2.3.1 of the Final Phase I Report.

The resulting forecast of available development budget funds is shown in Table 2.3-1. The real annual growth rates for the overall budget are 6.7 percent for budget estimates and 7.8 percent for projected actual expenditures. These rates compare with the Consultants' forecasted 7.2 percent growth rate for real GDP. Because of ordinary expenditures being assumed to be relatively less controllable than development expenditures, forecast development budget availabilities, and actual expenditures, both in total and for the transport sector, are forecast to grow at only 1 percent a year in real terms. These estimates implicitly assume that foreign economic assistance will remain relatively constant in real terms over the 5th Plan period. Lacking adequate data on foreign assistance, past or expected, the Consultants have no basis for any other assumption.

Since the transport sector budget as defined in the development plan does not include road construction funds of the Ministry of Local Administration, these have been projected seperately and are also shown in Table 2.3-1.

2.3.2 Transport Sector Finance

In order to assess the financial viability of the transport sector as a whole, the Consultants have prepared a series of financial analyses.

A financial profitability analysis has been prepared for each general company involved in transport, except for the Syrian Company for Oil Transport (SCOT) and the Syrian Company for Storage and Distribution of Oil Products (SADCOP). No analyses were prepared for SCOT because the company's revenues are completely dependent on the amount of oil shipped by Iraq, and as recent experience indicates, this is subject to wide fluctuations. Because SCOT is excluded, the revenue and expense for the use of its system for petroleum products has also been

Table 2.3-1

PROJECTIONS OF ESTIMATES AND ACTUAL GOVERNMENT BUDGET, REVENUES, DEFICITS, AND FUNDS POTENTIALLY AVAILABLE TO THE TRANSPORT SECTOR, 1981-1985

(SP million at constant prices)

Projected Estimates	1981	1982	1983	1984	1985
Ordinary Budget	15,540	17,249	19,147	21,253	23,591
Development Budget	14,140	14,281	14,424	14,568	14,714
Total	29,680	31,530	33,571	35,821	38,305
Revenues	9,540	10,112	10,719	11,362	12,044
Deficit	-20,140	-21,418	-22,852	-24,459	-26,261
Deficit % of Total	68%	68%	68%	72%	69%
Transport Sector Development Budget	1,414	1,428	1,442	1,457	1,471
Ministry of Local Administration-Road Funds[1]	84	84	85	86	87
Total Transport Investment Funds	1,498	1,512	1,527	1,543	1,558
Projected Actual	**1981**	**1982**	**1983**	**1984**	**1985**
Ordinary Budget	15,540	17,249	19,147	21,253	23,591
Development Budget	8,484	8,569	8,654	8,741	8,828
Total	24,024	25,818	27,801	29,994	32,419
Revenues	9,540	10,112	10,719	11,362	12,044
Deficit	-14,484	-15,706	-17,082	-18,632	-20,375
Deficit % of Total	60%	61%	61%	62%	63%
Transport Sector Development Budget	933	943	952	962	971
Ministry of Local Administration-Road Funds[1]	84	84	85	86	87
Total Transport Investment Funds	1,017	1,027	1,037	1,048	1,058

Source: Consultants' estimates.

[1] Assumed to equal expenditures.

excluded; but the amount is not significant in relation to the total. SADCOP has been excluded because its accounting system does not separate the operating costs of pipelines. The implicit assumption is that SADCOP's prices will include an amount equal to the old depreciation and operating costs and new investments in the pipelines it operates.

The financial profitability analyses cover the period 1981 to 1985 and show profit or loss before and after tax for the years 1981-2000 for each company. They are based on the Consultants' estimates and estimates of workload and existing tariffs or charges, except for parts, where the recommended tariff has been used. The details of the financial profitability analysis for each general company are presented in the modal volumes of the report.

The Consultants have prepared a forecast of revenues from road user charges for the same period, 1981-2000. Because of the structure of import duties, road user charges are very sensitive to the number of passenger cars which are imported. To allow for this, the Consultants prepared three alternative forecasts of road user charge revenues.

- Alternative A assumes that the number of passenger cars imported will be equal to the Consultants' estimate of demand.

- Alternative B assumes that the Government will restrict passenger car imports to 50 percent of estimated demand.

- Alternative C assumes that the Government will restrict passenger car imports to 25 percent of estimated demand.

Details of the Consultants' estimates of road user charge revenues are presented in Volume IV, Chapter 7.

The resulting financial profit or loss and road user charges were then combined with the Consultants' estimated investment requirements to prepare a financial plan for each general company and for the road sector. (In the case of roads, road maintenance was included with investments to make the sector comparable to the general companies.) The plans are divided into foreign exchange and local currency. The detailed results for each company and for roads are presented in the finance chapters of Volumes III through VI. They are summarized in Tables 2.3-2, 2.3-3, and 2.3-4 of this volume.

It should be emphasized that these financial plans are internal to the transport sector and do not reflect the financial costs to the country as a whole They do not include income tax paid to the Government by the general companies. This is sizeable, amounting to SP 1.4 billion over the 5th Plan period and an

estimated SP 12.7 billion from 1981 to 2000. Vehicle investments are excluded, because they are primarily private investments, and the total financial cost of transport is understated by the amount. (Vehicle investment requirements are discussed in Chapter 4 below, and in Chapter 7 of Volume III.) Interest charges on foreign loans are also excluded because the requisite data were not available, and this also understates the total financial costs of transport. However, for concessionary loans, the effect in real terms is minimal.

Table 2.3-2 summarizes the financial plan for roads, by plan period, from 1981 to 2000. The table clearly demonstrates the impact of import duties on passenger cars. During the 5th Plan period, road user charges exceed investments by SP 1.5 billion if passenger car imports are not restricted (Alternative A), but there is a deficit of SP 1.2 billion if imports are restricted to 25 percent of demand (Alternative C). In all three alternatives, there is a substantial deficit in foreign exchange, since road user charges are primarily internal.

Table 2.3-3 summarizes the financial plans for the general companies. Only three companies can finance investments during the 5th Plan period. This is due to the heavy investment levels during the plan, most of which is for committed projects. Syrianair shows an excess of funds available only because of the proceeds from the recommended sale of the B 747 SP aircraft. By far the most significant deficit is the SP 2.7 billion shortfall in railways. As with roads, there is a substantial foreign exchange deficit, which totals SP 1.1 billion for the 5th Plan period, but it turns positive in subsequent years.

Table 2.3-4 combines Tables 2.3-2 and 2.3-3 to show the financial situation for the transport sector as a whole. Committed investments cause an overall deficit for the 5th Plan period that ranges from SP 1.0 billion to SP 3.7 billion, depending on the policy on automobile import restrictions. Under all three alternatives the foreign exchange deficit for internal financing is the equivalent of SP 2.9 billion. The results change in subsequent plan periods, as committed projects are completed and new additional investments are limited. Over the 20-year period to 2000, the transport sector shows a slight surplus of internally generated foreign exchange and a large overall surplus, which ranges from SP 11.8 billion under Alternative C to SP 32.2 billion under Alternative A.

Table 2.3-2

ROAD FINANCIAL PLAN, 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
ROADS															
Investments	1,725	1,726	3,451	535	534	1,069	697	696	1,393	1,065	1,064	2,129	4,114	4,110	8,042
Alternative A															
Funds Available	72	5,057	5,129	98	6,858	6,956	125	9,880	10,005	159	14,151	14,310	454	35,946	36,400
Excess/Deficit	-1,653	3,331	1,678	-437	6,324	5,887	-572	9,184	8,612	-906	13,087	12,181	-3,660	31,836	28,358
Alternative B															
Funds Available	72	3,318	3,390	98	4,378	4,476	125	6,161	6,286	159	8,527	8,686	454	22,384	22,83[illegible]
Excess/Deficit	-1,653	1,592	-61	-437	3,844	3,407	-572	5,465	4,893	-906	7,463	6,557	-3,660	18,274	14,79[illegible]
Alternative C															
Funds Available	72	2,397	2,469	98	3,138	3,236	125	4,302	4,427	159	5,715	5,874	454	15,552	16,006
Excess/Deficit	-1,653	671	-982	-437	2,604	2,167	-572	3,606	3,034	-906	4,651	3,745	-3,660	11,442	7,964

Source: Consultants' estimates.

Note: FO.EX. = Foreign Exchange; LO.CU. = Local Currency.

Table 2.3-3

OTHER MODES FINANCIAL PLAN, 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
LATTAKIA PORT COMPANY															
Investments	284	357	641	17	-	17	15	-	15	15	-	15	331	357	688
Funds Available	98	282	380	133	149	281	163	144	307	199	140	339	593	714	1,307
Excess/Deficit	-186	-75	-261	116	149	265	148	144	292	184	140	324	262	357	619
TARTOUS PORT COMPANY															
Investments	230	220	450	22	-	22	20	-	20	20	-	20	292	220	512
Funds Available	112	326	438	159	201	360	175	207	382	191	215	406	637	949	1,586
Excess/Deficit	-118	106	-12	137	201	338	155	207	362	171	215	386	345	729	1,074
SYRIAN ARAB AIRLINES															
Investments	507	-	507	381	-	381	314	-	314	381	-	381	1,582	-	1,582
Funds Available	550	260	810	429	593	1,022	742	773	1,515	873	1,067	1,940	2,594	2,693	5,287
Excess/Deficit	43	260	303	48	593	641	428	773	1,201	492	1,067	1,559	1,012	2,693	3,705
SYRIAN NAVIGATION CO.															
Investments	90	-	90	113	-	113	113	-	113	113	-	113	428	-	428
Funds Available	224	-190	54	357	-293	64	514	-419	95	723	-587	136	1,838	-1,490	348
Excess/Deficit	154	-190	-36	244	-293	-49	401	-419	-18	610	587	23	1,410	-1,490	-80
SYRIAN-JORDANIAN NAVIGATION CO.															
Investments	23	-	23	113	-	113	113	-	113	113	-	113	360	-	360
Funds Available	132	-99	33	262	-210	52	481	-385	96	666	-531	135	1,540	-1,225	315
Excess/Deficit	109	-99	10	149	-210	-61	368	-385	-17	553	-531	22	1,180	-1,225	-45
RAILS															
Investments	1,229	1,461	2,690	132	78	210	165	93	258	132	52	184	1,658	1,684	3,342
Funds Available	89	-95	-6	59	6	65	89	4	93	119	2	121	356	-83	273
Excess/Deficit	-1,140	-1,556	-2,696	-73	-72	-145	-76	-89	-165	-13	-50	-63	-1,302	-1,767	-3,069
SYRIAN CRUDE OIL TRANSPORT CO.															
Investments	88	38	126	-	-	-	-	-	-	-	-	-	88	38	126
Funds Available	-27	380	353	-27	381	354	-28	397	369	-30	414	384	-112	1,572	1,461
Excess/Deficit	-115	342	227	-27	381	354	-28	397	369	-30	414	384	-200	1,534	1,334

Table 2.3-3 (continued)

OTHER MODES FINANCIAL PLAN, 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
DIRECTORATE OF CIVIL AVIATION															
Investments	152	153	305	43	101	144	43	99	142	24	55	79	262	408	670
Funds Available	157	-56	101	303	-110	193	467	-182	285	667	-277	390	1,594	-625	969
Excess/Deficit	5	-209	-204	260	-211	49	424	-281	143	643	-332	311	1,332	-1,033	299
Subtotal Excess/Deficit	-1,248	-1,421	-2,669	854	538	1,392	1,820	347	2,167	2,610	336	2,946	4,036	-200	3,836
Subtotal Cumulative Excess/Deficit	-1,248	-1,421	-2,669	-394	-883	-1,277	1,426	-536	890	4,036	-200	3,836	-	-	-

Source: Consultants' estimates.

Notes: Funds available after tax.
FO.EX. = Foreign Exchange; LO.CU. = Local Currency.

Table 2.3-4

TOTAL TRANSPORT SECTOR FINANCIAL PLAN, 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
Alternative A															
Excess/Deficit	-2,901	1,910	-991	417	6,862	7,279	1,248	9,531	10,779	1,704	13,423	15,127	468	31,726	32,194
Cumulative Excess/Deficit	-2,901	1,910	-991	-2,484	8,772	6,288	-1,236	18,303	17,067	468	31,726	32,194	-	-	-
Alternative B															
Excess/Deficit	-2,901	171	-2,730	417	4,382	4,799	1,248	5,812	7,060	1,704	7,799	9,503	468	18,164	18,632
Cumulative Excess/Deficit	-2,901	171	-2,730	-2,484	4,553	2,069	1,236	10,365	7,711	468	18,164	18,632	-	-	-
Alternative C															
Excess/Deficit	-2,901	-750	-3,651	417	3,142	3,559	1,248	3,953	5,201	1,704	4,987	6,691	468	11,332	11,800
Cumulative Excess/Deficit	-2,901	-750	-3,651	-2,484	2,392	-92	-1,236	6,345	5,109	468	11,332	11,800	-	-	-

Source: Consultants' estimates.

Notes: Funds available after tax.
FO.EX. = Foreign Exchange; LO.CU = Local Currency.

CHAPTER 3

ALLOCATION OF TRANSPORT DEMAND AMONG MODES

Chapter 3

ALLOCATION OF TRANSPORT DEMAND AMONG MODES

3.1 INTRODUCTION

In this study a formative approach was taken in forecasting future transport demand. The approach starts from the macro-economic model which predicts national economic indicators, and moves to the interpretation of changes in economic activities in each zone and then to movements (origins and destinations) of commodities and passengers. The resulting series of analyses and their results are presented in Volume II.

The next step in the transport demand analysis is the allocation among different modes of the total demand explained in Volume II. In this study the allocation of demand among different modes, called modal split, has been analyzed for road, rail, and pipeline transport. Due to the very limited nature of the domestic air service with respect to the total demand, the air transport demand has been analyzed independently and the results are shown in Volume VI, Part I, Chapter B-4. The choice of pipeline is not, particularly in Syria, governed by the general market. Pipelines can and should be chosen on purely economic grounds so that they are allocated the optimum amount. An economic analysis of feasible future pipeline expansions is presented in Volume VI, Part II, Chapter A-6.

By 1985 almost all of Syria's major corridors will be served by parallel first class highways and railways. The question of transport demand allocation between these two modes is of great importance. Unlike pipelines, the modal split between these two modes is largely the result of market forces, although government policies may play an important role in guiding such market behavior. A realistic and practical approach to determine the modal split between these two modes, would therefore incorporate an estimation of likely market behavior rather than determine a theoretical optimal modal split which is unattainable.

The allocation of passenger and commodity transport demand between the road and the rail modes has been analyzed considering market behavior and its changes under different policies. This chapter describes the results and their implications.

3.2 COMMODITY MODAL SPLIT

3.2.1 General

Given the substantial sunk costs resulting from the committed investments in expansion of the CFS railway, the economic advantages of maximizing utilization of those railway facilities are clear. As a result, the Consultants' commodity modal split methodology is based on a determination of potential railway commodity traffic, with the residual assigned to roads. The only exception is refined petroleum products, where shipment by rail versus pipeline can be subjected to specific economic analysis. This analysis is presented in Volume VI, Part I, Chapter A-6.

The railway is potentially in competition with other modes of transport for all its freight traffic. Some traffic, such as transit freight and phosphates in bulk, are virtually captive to rail. Extremely inefficient rail operation would be required before it would affect the amount of this traffic carried by rail. But for the remainder, rail is in the market with trucks and pipelines and, to a limited extent, aircraft. Choice of mode and the volume of rail traffic on each route thus ultimately depends on the relative inter-modal tariffs and the quantities and qualities of service offered. The division of traffic between the modes (the modal split) is influenced indirectly by Government policy to a large degree; tariffs are regulated, as are public sector salaries, fuel prices, and much of the investment in the transport sector. With tariffs and service quality both heavily influenced by the Government, the modal split will be optimal from an economic point of view if Government policy is neutral between the modes. With transport so much in the political arena, and a mix of public and private sector organizations involved, such a result is unlikely in practice. Indeed, it has not been achieved in any of the most developed countries. The existing and future commodity modal splits will therefore result from a mixture of economic, political, and social factors, and the traffic forecast and consequent development plans have to recognize that fact.

The forecast of railway commodity traffic involved three steps: projection of the future total transport market, definition of the railway network, and estimation of the rail share of each movement. A single projection of the transport market has been made, as described in Volume II. This is a simplification in that the supply-demand interaction is taken as given, whereas in fact, the provision (or lack) of additional links or services generates (or fails to generate) new traffic, particularly transit freight.

Although this can be a critical factor on a particular link, for the system as a whole the network and service assumptions will have only a marginal effect on total traffic.

The railway network in operation in 1985 is assumed to include the new and reconstructed sections of the Damascus-Aleppo line and the Deir Ez Zor-Albu Kamal line. For 2000, the Lattakia-Tartous line and a standard gauge line from Damascus to Amman are assumed to be in operation. The combined CFS and CFH system is treated as a single network from 1986 onwards.

Estimation of future rail market shares is exceptionally difficult given the limited operating experience with the existing new lines and the coming into service of such major routes as Homs to Damascus and the re-gauged Damascus to Amman line.

The Consultants' forecast of freight transport by commodity given in Volume II was treated for analysis purposes as five commodity groups and transit traffic. The classification of major commodities into these groups is as follows:

Group 1 Phosphate, petroleum products.

Group 2 Bulk building materials such as sand and gravel.

Group 3 Cement, cereals, other bulk goods.

Group 4 Intermediate value items - iron and steel, fertilizer, processed food stuffs, farm products, sugar beet, non-bulk building materials.

Group 5 High-value goods - manufactured products, capital equipment, live animals, meat.

In 1979, about 56 percent of railway tonnage, excluding rail construction materials, was of group 1, 2, or 3 commodities, 24 percent was of group 4, 9 percent of group 5, and 11 percent was transit traffic. The share of bulk traffic will rise with the start of phosphate movements in 1980 and with a large growth projected for other bulk commodities. The CFS freight traffic plan for 1980 gives groups 1, 2, and 3 a share of a little over 68 percent of tonnage and 71 percent of ton-kilometerage.

Rail is naturally more competitive for the bulk commodities and over longer distances. Group 5 traffic is likely in the long term to be carried in volume by rail only in containers.

While high shares of bulk movements are virtually certain between rail-connected points, the share of group 4 traffic that will be attracted is highly sensitive to the relative price and service qualities of road transport.

Table 3.2-1 shows the projected rail traffic for 1985 by group and by origin-destination. In general, the rail share has been taken to rise with distance and the figures for both directions added together. Limiting shares on any one origin-destination of 70 percent for groups 1 and 3, 45 percent for group 4, 35 percent for group 2, and 15 percent for group 5 are used. For phosphate movements, fuel oil from Homs to Mhardeh, and transit traffic, specific volumes have been projected based on discussions with CFS officials and on other sources. The total traffic forecast for 1985 is 6.2 million tons, [illegible] billion ton-kilometers. Of the tonnage, 75 percent is of bulk commodities (groups 1, 2, and 3), 12 percent is group 4, 2 percent is group 5, and 11 percent is transit traffic. In comparing the 1985 forecast with the total of 1.9 million tons carried in 1979, the breakdown of the increase is as follows:

Component	Tons (million)
1979 Traffic	1.91
Less Railway Construction Materials	0.44
Base Traffic 1979	1.47
Natural Growth in Base Traffic 1979 to 1985	0.50
Phosphates to Homs/Tartous	1.53
Fuel Oil to Mhardeh	0.40
Increase in Transit Traffic	0.52
New Traffic to Damascus	1.18
Other New Traffic	0.63
Total	6.23

The projection thus implies the development of some new traffic by rail apart from that due to the opening of the line to Damascus but far less new traffic than such a large overall growth would suggest at first sight. Rail service to Tartous and Homs has been badly affected recently by line construction and reconstruction work. Given the much-improved service to be expected by 1985 and proper attention to marketing, the forecast is considered attainable.

Table 3.2-1

RAIL FREIGHT TRAFFIC PROJECTION, 1985

(000 tons)

Route	Commodity Group 1	2	3	4	5	Transit	Total
Lattakia-Homs	110	-	-	18	-	-	128
Lattakia-Aleppo	77	12	-	78	24	-	191
Lattakia-Damascus	-	23	-	74	33	-	130
Lattakia-Al Raqqa	20	-	-	-	-	-	20
Lattakia-Deir Ez Zor	11	-	-	-	-	-	11
Lattakia-Al Hassakeh	14	-	-	-	-	-	14
Lattakia-Al Kamishli	-	14	-	-	-	-	14
Lattakia-Iraq	-	-	-	-	-	250	250
Tartous-Damascus	-	-	449	66	25	-	540
Tartous-Homs	82	12	-	27	-	-	121
Tartous-Hama	-	12	152	22	-	-	186
Tartous-Aleppo	-	-	103	59	14	-	176
Tartous-Deir Ez Zor	-	-	12	-	-	-	12
Tartous-Iraq	-	-	-	-	-	30	30
Tartous-Phosphate Mines	930	-	-	-	-	-	930
Homs-Damascus	338	25	-	74	-	-	437
Homs-Hama	24	36	-	11	-	-	71
Homs-Aleppo	255	19	-	56	-	-	330
Homs-Al Raqqa	524	10	29	-	-	-	563
Homs-Deir Ez Zor	32	-	-	-	-	-	32
Homs-Al Hassakeh	42	-	-	-	-	-	42
Homs-Al Kamishli	31	-	13	-	-	-	44
Homs-Phosphate Mines	600	-	-	-	-	-	600
Homs-Mhardeh	400	-	-	-	-	-	400
Aleppo-Damascus	-	-	-	35	-	-	35
Aleppo-Hama	-	-	-	20	-	-	20
Aleppo-Al Raqqa	-	-	31	24	-	-	55
Aleppo-Deir Ez Zor	-	-	26	19	-	-	45
Aleppo-Al Hassakeh	-	-	13	25	-	-	38
Aleppo-Al Kamishli	-	-	31	13	-	-	44
Damascus-Hama	-	26	-	10	-	-	36
Deir Ez Zor-Al Kamishli	-	12	-	13	-	-	25
Turkey (Midan Ikbis)-Iraq (Albu Kamal)	-	-	-	-	-	250	250
Turkey (Al Kamishli)-Iraq (Ya'roubia)	-	-	-	-	-	150	150
Others	-	51	70	87	50	-	258
Total	3490	252	929	731	146	680	6228

Source: Consultants' estimates.

Note: Individual flows shown only if over 9500 tons.

Projections of railway freight traffic in 2000 have been made with medium and high rail share alternatives. Case A1, the medium projection, is in general lower than the high case, B2, by 25 percent for group 1, 20 percent for groups 2 and 3, 30 percent for group 4, and 50 percent for group 5 commodities. The phosphate flows, the fuel oil flow from Homs to Mhardeh, and transit traffic are the same in both cases. The traffic projections for case B2, the most economic system alternative, are given in Table 3.2-2. Transit traffic growth is projected explicitly, as described in Volume II, Chapter 5. An increase in rail shares is forecast between 1985 and 2000. The scope for increases in share is far more limited than that for passenger traffic because of the shares already obtaining in 1985.

The addition of a standard gauge Hijaz line is assumed to result in transit traffic of 0.8 million tons between Tartous and Jordan/Saudi Arabia. Fuel oil movement between Homs and Al Raqqa is by pipeline for 2000, with onward distribution from Al Raqqa to Deir Ez Zor, Al Hassakeh, and Al Kamishli by rail.

The case A1 projection for 2000 results in a total tonnage of 14.1 million, or 5.14 billion ton-kilometers. Of the tonnage, 69 percent is of group 2 or 3 commodities, 11 percent of group 4, 2 percent of group 5, and 18 percent is transit traffic. With case B2, traffic is 16.5 million tons, or 6.19 billion ton-kilometers.

3.3 PASSENGER MODAL SPLIT

3.3.1 Calibration

Present Situation

A variety of means of transportation are offered to Syrian intercity passengers. They can be divided into three main categories:

- privately owned,
- demand-oriented public transport, and
- scheduled public transport.

The first category consists mainly of private passenger cars. A general observation is that their share of total traffic is higher for recreational and tourism trips and also higher on trips between major cities. In many cases, pickup trucks are used for passenger transport as well. Normally their main use is goods transport, particularly for farmers, but in actuality they are extensively used for the trips of the owners and their families and friends. The use of pickups is not frequent for medium- and long-distance hauls but is high for short distances

Table 3.2-2

RAIL FREIGHT TRAFFIC PROJECTION, 2000 CASE B2

(000 tons)

Route	Commodity Group 1	2	3	4	5	Transit	Total
Lattakia-Aleppo	321	53	143	311	67	-	895
Lattakia-Al Raqqa	-	-	12	10	-	-	22
Lattakia-Al Hassakeh	-	-	-	18	-	-	18
Lattakia-Iraq	-	-	-	-	-	800	800
Lattakia-Damascus	-	40	82	148	128	-	398
Lattakia-Homs	265	10	39	20	15	-	349
Lattakia-Hama	-	-	18	15	-	-	33
Tartous-Damascus	-	23	532	127	108	-	790
Tartous-Homs	213	-	260	80	14	-	567
Tartous-Hama	-	20	20	37	-	-	77
Tartous-Aleppo	-	22	765	120	41	-	948
Tartous-Al Raqqa	-	-	-	-	16	-	16
Tartous-Iraq	-	-	-	-	-	200	200
Tartous-Jordan	-	-	-	-	-	800	800
Tartous-Phosphate Mines	600	-	-	-	-	-	600
Homs-Damascus	705	76	187	149	26	-	1143
Homs-Aleppo	1261	137	341	99	-	-	1838
Al Raqqa-Deir Ez Zor	104	-	-	-	-	-	104
Al Raqqa-Al Hassakeh	153	-	18	20	-	-	191
Al Raqqa-Al Kamishli	164	-	-	-	-	-	164
Homs-Al Raqqa	19	-	32	23	-	-	74
Homs-Deir Ez Zor	-	14	49	10	-	-	73
Homs-Al Hassakeh	18	-	16	26	-	-	60
Homs-Al Kamishli	83	-	61	-	-	-	144
Homs-Phosphate Mines	2400	-	-	-	-	-	2400
Homs-Hama	107	106	23	-	-	-	236
Homs-Mhardeh	500	-	-	-	-	-	500
Homs-Jordan	-	-	-	14	-	-	14
Aleppo-Jordan	-	-	-	39	27	-	66
Aleppo-Damascus	-	57	105	117	82	-	361
Aleppo-Hama	-	12	27	40	-	-	79
Aleppo-Al Raqqa	-	-	182	147	-	-	329
Aleppo-Deir Ez Zor	-	18	108	64	-	-	190
Aleppo-Al Hassakeh	-	-	123	99	-	-	222
Aleppo-Al Kamishli	-	29	225	40	32	-	326
Damascus-Jordan	-	-	-	94	-	-	94
Damascus-Hama	-	18	44	29	19	-	110

Table 3.2-2 (Continued)

RAIL FREIGHT TRAFFIC PROJECTION, 2000 CASE B2
(000 tons)

Route	Commodity Group 1	2	3	4	5	Transit	Total
Damascus-Al Hassakeh	-	-	-	65	-	-	65
Damascus-Al Raqqa	-	-	-	22	-	-	22
Damascus-Deir Ez Zor	-	-	-	34	-	-	34
Hama-Al Kamishli	-	-	27	-	-	-	27
Hama-Deir Ez Zor	-	-	-	11	-	-	11
Deir Ez Zor-Al Hassakeh	-	15	34	16	-	-	65
Deir Ez Zor-Al Kamishli	-	18	18	40	-	-	76
Turkey (Midan Ikbis)-Iraq (Albu Kamal)	-	-	-	-	-	500	500
Turkey (Al Kamishli)-Iraq (Ya'roubia)	-	-	-	-	-	250	250
Others	-	12	54	57	69	-	192
Total	6913	680	3545	2141	644	2550	16473

Source: Consultants' estimates.

Note: Individual flows shown only if over 9500 tons.

and very high for intra-Mohafaza and intra-Mantika traffic. One exception to this rule is when there is undercapacity of demand-oriented public transport, especially microbuses. In this case, the shares of pickups used for passenger transport are consistently higher.

The second category consists of service taxis, microbuses, and large buses. They all have the common characteristic of not operating according to a schedule; they are totally demand oriented. They leave whenever they are full or almost full. There is, however, a maximum number of allowed trips a day or month for microbuses and large buses. The tariffs, fixed by the Ministry of Supply and Internal Trade, are generally observed by micro- and large buses, whereas taxis are known to frequently charge more than the published fare. Micro- and large buses operate on pre-defined lines with few or no stops between origin and destination. It appears that where the capacity of demand-oriented public transport is insufficient, some pickup trucks take over a taxi function, especially for the traffic between smaller villages and centers.

The third category consists presently only of the Syrian railway (CFS) rail lines, which offer scheduled passenger service on the Lattakia-Aleppo, Homs-Aleppo, Aleppo-Al Kamishli, and Aleppo-Turkish border lines.

Service is relatively fast (except Homs-Aleppo), the tariffs are fixed and kept, although they are very different from line to line. The Hijaz railway (CFH) maintains a passenger service from Damascus to Dera'a. The public-owned Karnak Company runs scheduled services on some routes.

Methodology

The purpose of this analysis is to determine a set of principles according to which Syrian passengers make their modal choice. These principles will then serve as a basis for forecasting the modal choice in the future under different circumstances. The first difficulty encountered in this task is that for a majority of origin and destination (O & D) pairs the present situation seems to be governed by capacity considerations, that is, the demand exceeds supply, and the user really has no choice and is often compelled to use whatever transport is available. This observation is confirmed by the high load factors, which are frequently greater than 100 percent, encountered all over the country. The analysis had therefore to be restricted to O & D pairs where the demand is sufficiently high to generate a sufficiently high supply and thus to allow the user some kind of choice on grounds of tariffs, time, etc. For this reason, only O & D pairs with more than 200 total

passenger trips per day were considered. There is another reason for this selection. Since the O & D survey was done on a sample basis, the O & D flows to be considered must be sufficiently high to be derived from a representative sample.

Some of the flows had to be disregarded because they were obviously distorted (for example, only partial information about bus passengers was available). For the same reasons, all intra-Mohafaza O & Ds were skipped. Approximately 50 O & D pairs were left after this first screening.

The information about tariffs for taxis, minibuses, and buses made available to the Consultants covered only approximately 20 of the selected O & Ds. The Consultants attempted to expand them with direct interviews at bus and taxi terminals, but the present tariffs differ too much from the base year's (the increases have been different, sometimes there were even decreases) to make them compatible with the 1979 tariffs, so the analysis had to be restricted to approximately 20 O & D pairs. These O & Ds are almost totally from and to Damascus and Aleppo plus a number of relationships between major Mohafaza centers

For each of these O & D pairs, the following sets of 1979 figures were established:

- share of passenger trips by private car, pickup, taxi minibus, bus, and rail,

- distance by road (fastest path) and by rail,

- travel time by passenger car or taxi, bus, microbus, and rail,

- financial vehicle operating costs for passenger cars,

- one-way tariffs for taxi, minibus, bus, and rail (second class),

- frequency for minibus, bus, and rail, and

- private car ownership in 1979 by Mohafaza.

These sets of figures were established to identify relationships between the independent variables (x_i) listed above and the dependent variables (y):

- share of different vehicle types or

- ratio between traffic on different vehicle-types

Regressions were performed using the Zilog-Basic Statistical Package.

Basically, four kinds of mathematical relationships were tested:

- Linear $y = a + bx$ or

$$y = \sum_{i=1}^{5} b_i x_i$$

- Logarithmic $y = b \ln(x)$ or

$$y = \sum_{i=1}^{5} b_i \ln(x_i)$$

- Exponential $y = aebx$ or

$$y = \prod_{i=1}^{5} aebx$$

- Power $y = axb$ or

$$y = \prod_{i=1}^{5} a_i x_i^b$$

As shown in the formulae, not only simple regressions but also multiple regressions with up to five independent variables were tried. The criteria which led to the selection of one equation were mainly:

- The statistical indicators:

. the coefficient of simple or multiple correlation, and subordinately,

. the standard error of estimate (which in modal split analyses must be expected to be quite high due to the vast scatter of points),

. the t-value, and

. the residuals, the analysis of which indicates whether the selected curve shape is correct.

- The plausibility and interpretability of the resulting equations.

- The equations' proneness for use forecasts; that is, their validity for input values outside of the present range and the possibility of soundly forecasting the input variables and of changing the coefficients for the future.

Conclusions

It must generally be stated that extremely high correlation indicators cannot be expected in this kind of analysis for several reasons:

- A number of subjective, non-economic factors govern the modal choice of passengers.

- The aggregation of a multitude of individual O & D pairs into Mantika-center to Mantika-center flows may cause considerable distortions.

- The passengers are often charged more than the official tariffs, especially in taxis.

- The samples are often too small for analysis with a large number of degrees of freedom.

Passenger Cars and Pickup Trucks (PC, PU)

At the present level of car ownership in Syria (7.3 passenger cars per 1,000 inhabitants), roughly only 1 out of every 23 households owns a passenger car. It is obvious that the main factor influencing the choice of a passenger car for a trip is the availability of such a car. This suggests the use of a trip-end assumption making the share of trips by private cars dependent on the motorization index of the Mantika of origin of the trip. The 1978 motorization data are available only on a Mohafaza basis (Table 3.3-1) and include all Government-owned vehicles in Damascus Mohafaza. A number of assumptions had to be made as to the distribution of vehicles among the Manatik as well as the share of available passenger cars used for inter-city traffic. This explains the low but acceptable fit (R = 0.75) of the resulting equation:

$$SPLIT\ (PC,O) = 1.71\ (MOT\ (O,D))^{0.74}$$

where

MOT = Motorization Index = Intercity PC/1,000 inhabitants.

Table 3.3-1

CAR OWNERSHIP IN SYRIA, 1978

Mohafaza	Passengers cars	Total	Inhabitants (000)	Motorization (Vehicles/1000 Inhabitants) Passenger Cars 1000 Inhabitants	Motorization (Vehicles/1000 Inhabitants) Total Vehicles/ 1000 Inhabitants
Damascus + Quneitra	33,641	68,813	1,931 + 21	17.2	35.3
Aleppo	12,878	28,321	1,723	7.5	16.4
Homs	5,071	13,155	732	6.9	18.0
Hama	1,935	10,233	705	2.7	14.5
Lattakia	3,434	8,219	515	6.7	16.0
Deir Ez Zor	417	3,478	388	1.1	9.0
Idleb	470	4,169	498	1.2	8.4
Al Hassakeh	733	5,814	611	1.2	9.5
Al Raqqa	272	2,895	317	0.9	9.1
Al Suweida	262	2,060	179	1.5	11.5
Dera'a	163	1,905	308	0.5	6.2
Tartous	1,634	4,914	400	4.1	12.3
Syria	60,918	153,970	4,328	7.3	18.5

Source: Central Bureau of Statistics and Consultants' estimates.

The exponent of the equation represents the elasticity of the passenger car split to motorization; it is less than one because the use of private cars for intercity traffic does not increase at the same pace as mortorization. This pattern generally appears and is explained by the increased use of passenger cars for urban traffic the lower average yearly use.

Considerations on a pure non-captive rider basis are not sufficient to explain the variety of passenger car shares of the different flows originating in the same Mantika. It was observed that the share of trips by private cars is higher than the average of the zone of origin on such O & D pairs linking main centers to tourist resorts and to one another. This reflects the fact that on such O & D pairs the trip purposes of tourism, recreation, and business are obviously more strongly represented. Trips with these purposes are performed more frequently by passengers belonging to higher income groups, who are most likely to have a passenger car. Also, a private car is used, if available, more frequently for these than for other trip purposes. Three purposes were defined:

- business,
- tourism and recreation, and
- other

Based on their characteristics, O & Ds were classified in four categories:

a. Major Center: Damascus, Homs, Hama, Aleppo,

b. Mohafaza Center other than (a) and (c): Quneitra, Dera'a, Al Suweida, Tartous, Idleb, Al Raqqa, Deir Ez Zor, Al Hassakeh.

c. Tourist Centers: Zabadani, Safita, Dreikish, Lattakia, Al Hiffeh, Tadmur.

d. All other Manatik.

The trip purposes were assigned according to following matrix:

O/D	A	B	C	D
A	1	1	2	3
B	3	3	2	3
C	3	3	3	3
D	3	3	3	3

All 1979 O & D pairs were classified in the three trip purposes, and weights were given when one origin or destination fit more than one category. It was found that the passenger car share is different for the different trip purposes.

Trip Purpose	PC Share/Average PC Share = FACTOR
1	2.02
2	3.51
3	0.68

These ratios were assigned to the average passenger car trip share of each zone according to its characteristics and those of the destination.

Conclusions

$$\text{SPLIT (PC, O,D)} = 1.71 \times (\text{MOT(OD)})^{0.74} \times \text{FACTOR (D)}.$$

% [PC/1,000 inhabitants]

The observation that pickups are mainly used for passenger transport in short hauls is confirmed. A linear function adequately describes the reduction of pickup share as a function of distance.

$$\text{SPLIT (PU,O,D)} = 7.0 - 0.024 \times \text{Distance (O,D)}$$

% km

In other words, under normal circumstances, the pickup split is no higher than 7 percent of passenger trips, decreases by 1 percent every 50 kilometers, and is virtually nil for distances over 350 kilometers. The correlation coefficient of this equation is -0.9. This equation loses its validity in cases where there are shortages of other means of transport, mainly microbuses.

Railway

The extent of rail services offered to Syrian passengers is presently very limited. Basically, it consists only of two to three trains per day on the lines Lattakia-Aleppo-Deir Ez Zor-Al Kamishli. The other services on the Homs-Aleppo (CFS) and Damascus-Dera'a (CFH) lines are slow, infrequent, and cannot generally be considered to be competitive with road transport. Here again, therefore, the analysis of present patterns had to be limited to a reduced number of O & D pairs.

The tariff structure and speeds of the different lines are very different too. The tariffs for each line were established at

different times and then kept constant, so there is no definite relationship. As for the travel times, the situation is very varied as well, especially if compared with road travel times. Thus, beside the speed of the railway, other important factors influence the competition between road and rail. The features of the road that a rail line is competing with (from Lattakia to Aleppo, the rail line is new and designed for high speeds, the road old and slow; between Damascus and Dera'a the opposite is true), and the sometimes considerable differences in distance of the road and rail connection between two cities (e.g., the rail distance between Deir Ez Zor and Al Kamishli is 217 kilometers as opposed to 265 kilometers by road) affect the competition.

At any rate, a sufficiently reliable correlation (R = 0.78) was found linking the ratio between non-rail public (total traffic less private car and pickup trips) and rail traffic, and the ratios between the rail tariffs and travel times and the bus tariffs and travel times, in the form:

$$PUBTRA\ (O,D) = TOTTRA\ (O,D) - PCTRA\ (O,D) - PUTRA\ (O,D)$$

$$RAT(O,D) = \frac{PUBTRA(O,D)}{RLTRA\ (O,D)} - RLTRA(O,D) = 0.43e^{1.43}\ \frac{TARRL(O,D)}{TARBU(O,D)}$$

$$e^{0.76}\ \frac{TIMBU(O,D)}{TIMBU(O,D)}$$

$$SPL\ (RAIL,O,D) = 1/(1 + RAT(O,D))$$

where PUBTRA is the trips by public transport,
TOTTRA is the total trips,
PCTRA is the trips by passenger cars,
PUTRA is the trips by pickup trucks,
RAT is the ratio of trips by buses and trips by rail,
TARRL is the tariff by rail,
TARBU is the tariff by bus,
TIMRL is the travel time by rail,
TIMBU is the travel time by bus, and
SPL is the rail split.

This formula can be interpreted as follows:

The share of rail passenger traffic diminishes with rising comparative tariffs and travel times; however, the sensitivity to travel times is about half the sensitivity to tariffs.

The quality, comfort, reliability, etc. of railway service is obviously perceived by the passengers as being considerably

lower than those of buses, microbuses, and taxis. If tariffs and travel time for both rail and road were equal, still only 21 percent of passengers would use rail. In a hypothetical case where rail tariffs and times are only one-tenth of road tariffs and times, only 65 percent of passengers would use rail.

This bias against railways is thought to be mainly caused by two factors: the relative infrequency of rail service (the demand-oriented bus and minibus system insures minimum waiting times), and lack of accessibility (mostly main centers are served by rail). These conditions are not likely to change much in the future. It must, however, be pointed out that the use of the pure travel time in the equation (excluding stops, transfers, and waiting times) is favorable to railways and thus reduces the negative bias.

The dependence of rail share on the tariff ratio has been calculated for travel time ratios ranging from 0.3 to 1.5. The results show that in the normal ranges of the influencing parameters,

$$\left(0.5 \leq \frac{TAR(RL)}{TAR(BU)} \leq 1.5 \text{ and } 0.3 \leq \frac{TIM(RL)}{TIM(BU)} \leq 1.5\right)$$

The rail share varies between 48 percent and 8 percent. The curves representing the change of rail share as a function of tariff ratio for a given time ratio are shown in Figure 3.3-1.

Taxi

Service (long distance) taxis are a favored means of transportation for intercity traffic. They normally start and end at one or a few points within a city, although loading or dropping passengers en route is not uncommon. Still, taxi operators tend to maximize their revenues by preferentially taking long-distance passengers. No schedules exist. A vehicle departs whenever it is full or the driver estimates the revenues are sufficient. In other words, the service taxi insures a very frequent service which is also fairly flexible as far as origins and destinations are concerned.

The tariffs are consistently higher than those of buses or minibuses, are established by the Ministry of Supply and Internal Trade, allow increases for journeys on non-paved roads, and overcharging is common. The regression analysis of the ratio between passenger trips by taxi and by micro- and larger buses led to a good correlation (R = 0.86), given the

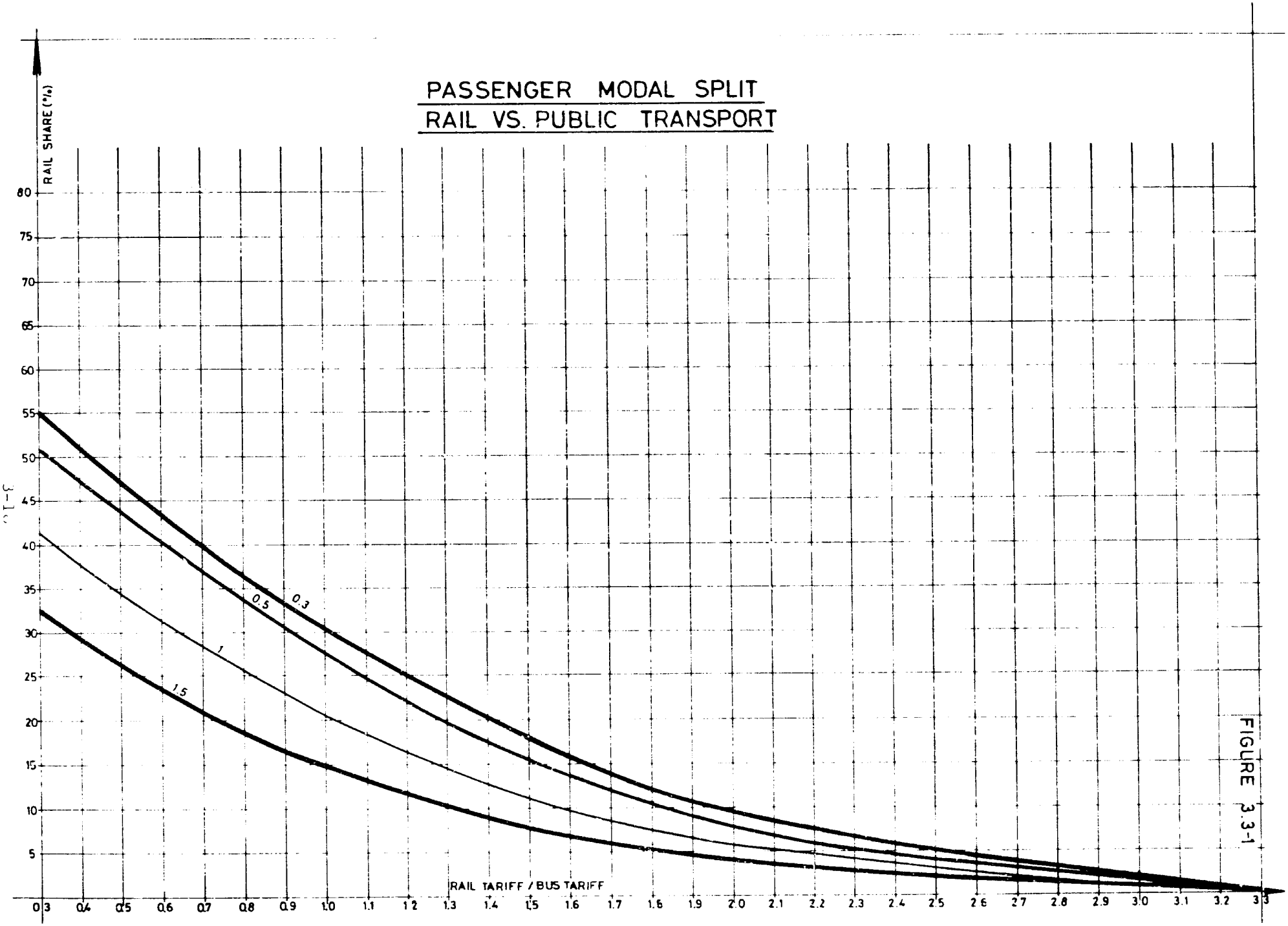
PASSENGER MODAL SPLIT
RAIL VS. PUBLIC TRANSPORT
RAIL SHARE (%)
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0.3
0.5
1
1.5
RAIL TARIFF / BUS TARIFF
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3.0
3.1
3.2
3.3

FIGURE 3.3-1

average headway of bus service and the difference between the tariffs.[1]

$$\frac{TRATX\ (O,D)}{TRAMB\ (O,D) + TRABU\ (O,D)} = 0.41 + 0.0315\ HEADPT\ (O,D)$$

$$-0.0001475[TARTX(O,D) - TARPT(O,D)]$$

where:

Headway Public Transport = HEADPT (O,D) =

$$\frac{14\ \text{hours} \times 60}{\text{Frequency MB} + \text{Frequency BU}} = \frac{840}{FREQMB\ (O,D) + FREQBU\ (O,D)}$$

and TARPT (O,D) = TARMB (O,D), unless FREQMB (O,D) = 0 in which case TARPT(O,D) = TARBU (O,D).

The constant factor of less than one implies a bias against taxis in the perception of passenger. Were bus and taxi to offer similar services (headways tend to 0) for the same tariff, only 30 percent of passengers would use a taxi. The negative bias is most likely due to three facts. Taxis tend to favor passengers travelling on the whole trip, so for all passengers the service does has not have the quality which was assumed. The frequency of taxis is not endless as it is implicitly assumed in the equation (taxi headway = 0). The actual tariffs are often higher than the official ones, which were used to calibrate the equation.

The equation implies a time value for taxi users. The effect on the taxi share of a 10 minute headway of public transport or of a difference in tariffs of 21.4 piasters is the same. The implicit time value of 21.4 piasters per minute = SP 12.80 per hour and matches well with the average time value for a taxi passenger of SP 10.38 calculated in Phase I. This puts the average taxi user in the SP 2,400 per month wage class, which according to the Consultants' income distribution would include roughly 30 percent of Syria's working population.[2]

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[1]Headway is the time between departures.

[2]Assuming time value = 90 percent of average wage for work trips, 30 percent of average for other trip purposes. With the surveyed trip purpose distribution, an average time value of 85 percent of average wage is taken.

The dependence of the taxi share on the difference in tariffs, rather than on the ratio of tariffs decreases the share of taxis with increasing distances, an effect that is both reasonable and can actually be observed.

Microbus and Bus

Bus services in Syria presently do not run on schedules, except for the buses of the state-owned Karnak Company. Operators for both micro- and large buses are private and small sized. A bus departs when the vehicle is between 80 percent and 100 percent full, or even less if the driver decides to leave. Departure and arrival of buses occurs at fixed points within the cities or villages and minimum amounts of boarding or getting off the bus en route are observed. The maximum number of daily trips is not at the operator's discretion but is regulated by licence. In summary, buses and microbuses offer a service comparable to service taxis except for the headways, which are longer. Microbuses normally contain up to 20 passengers, a larger bus carries up to 50 passengers, as opposed to a taxi, which carries 5 to 7 people, and there is less flexibility as far as origin and destination are concerned. Fares, established by the Ministry for Supply and International Trade, are presently extremely low, especially for large buses. Official tariffs are normally applied. Tariffs are consistently higher for microbuses.

The equation which was found for the split MB/BU shows an R = 0.74 and has a similar shape to the one found for taxis.

$$\frac{TRAMB\ (O,D)}{TRABU\ (O,D)} = 1.64 - 0.0032\ (TARMB\ (O,D) - TARBU\ (O,D)) + 0.033\ (HEADBU(O,D) - HEADMB(O,D))$$

The constant greater than one indicates that, in the perception of users, microbuses are preferred because they are more flexible, more comfortable, and less crowded. If tariffs and frequencies of microbuses and buses were the same, 68 percent of users would still prefer microbuses. This perference is not very strong, however, because if frequencies are kept the same, a difference in tariff of SP 2 would cancel it. At the present per-kilometer rates, this already occurs at 133 kilometers.

The implicit time value of this equation is that passengers are willing to pay SP 1.03 more to avoid waiting ten minutes. This 10.3 piasters per minute equals SP 6.19 per hour, which corresponds to an average wage of SP 1,100 per month, roughly equivalent to the income in the first, second, and third quintiles,

that is, 60 percent of the population.[3] This value matches well with the time value of SP 5.48 per hour calculated in Phase I. The dependence of the microbus/bus ratio on tariff difference rather than tariff ratio causes the microbus share to decrease with the distance if constant per kilometer rates are assumed.

3.3.2 Adjustment of Forecast Parameters

In addition to forecasting the parameters (like distances, times, tariffs) of the modal split equations, some adjustment must also be made affecting the coefficients of these equations, particularly when those coefficients implicitly contain other parameters which may change in the future.

The following adjustments were considered:

- Private car share. Since it is explicitly linked to motorization, which in turn depends on the GDP per head, no adjustments were made.

- Pickups. The use of pickups and trucks for passenger transport will be ruled by two trends. On one side, the number of pickups -- a relatively cheap vehicle with several uses - will keep growing at a considerable rate. On the other hand, its use for passenger transport will decrease with increased ownership of private cars and improving public service. The two effects were considered to compensate for this and no adjustment was made.

- Railway. There is no implicit time value in the equation as it does not contain absolute tariffs or times but only pure numbers. Therefore, no adjustment was made.

- Taxi. There are two parameters contained in the equation which will change in the future. The coefficient of the headway of public transport, which includes the implied time value and the constant, represents the share of people which would still choose taxi if the bus service were the same at the same price. As for the time value; two opposing factors have to be considered. The growth of GDP per capita increases the time value; the change of trip purpose mix (there will be more non-work related trips in the future) reduces it. With the trip purpose mix assumed for 2000 (50 percent work, 35 percent social, 15 percent tourist), the time value will be 60 percent

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[3]Assuming time value = 90 percent of average wage for work trips, 30 percent of average wage for other trip purposes. With the surveyed trip purpose distribution, an average time value of 89 percent of average wage is calculated.

of average wage versus 85 percent in 1979. The latter, in turn, ill have grown by 1.82 in real terms. The time value in 2000 will therefore be 1.28 times the present one and 1.07 times that in 1985. The constant factor reflects a comparative lack of use preference for taxis, due mainly to the perception of taxis overcharging, preferentially catering to high-revenue passengers, and sometimes having less than optimal headways. Due to the general increase in mobility, the even higher increase in non-economic trips, and the overall much more extensive bus service, the non preference is estimated to rise slightly in the futute. Only 20 percent of passengers are expected to use taxis in the indifference case in 2000 as opposed to 30 percent in 1979. The constant factor is thus 0.25 in 2000 and 0.35 in 1985.

The following equations were used:

$$\frac{TRATX\ (O,D)}{TRAMB\ (O,D) + TRABU\ (O,D)} = CONST\ I + AI\ [HEAD\ PT\ (O,D)]$$

$$- 0.0001475\ [TARIF\ TX(O,D) - TARIF\ PT(O,D)]$$

Where $HEAD\ PT\ (O,D) = \frac{14\ hours\ X\ 60}{Frequency\ MB + Frequency\ Bus}$, and

TARIF PT (O,D) = TARIF MB (O,D) unless

IF FREQ MB (O,D) = O, TARIF PT (O,D) = TARIF BU (O,D)

	1979: 0.41		1979: 0.0315
CONST 1 =	1985: 0.35	A1 =	1985: 0.0337
	2000: 0.25		2000: 0.0403

- Bus and Microbus. The time value for bus passengers will amount to 66 percent, versus 99 percent in 1979, of the average wage in 2000, so the implicit time value will increase by a factor of 1.35 in 2000 and 1.09 in 1985. The subjective preference for microbuses in the indifference case of 62 percent is expected to decrease as the service quality of buses and microbuses becomes more and more similar, and to be 55 percent in 2000. The constant would thus be 1.22 in 2000 and 1.49 in 1985.

The following equations were used:

$$\frac{TRA\ MB\ (O,D)}{TRA\ BU\ (O,D)} = CONST\ 2 + A2\ [HEAD\ BU\ (O,D) - HEAD\ MB\ (O,D)]$$
$$- 0.0032\ [TARIF\ MB\ (O,D) - TARIF\ BU\ (O,D)]$$

	1979: 1.64		1979: 0.033
CONST 2 =	1985: 1.49	A2 =	1985: 0.036
	2000: 1.22		2000: 0.045

3.3.3 Forecast of Influencing Variables

Private Car Ownership

Historical analysis of private car ownership in Syria is very difficult. More than anything, import and registration of passenger cars have been subjected to restrictions in connection with balance of payments problems. This explains the very unsteady trend in the years 1963-1973. In fact, with a growing population and a stagnating fleet, it took ten years for the private car ownership to again reach the 1964 figure of 3.86 passenger cars per 1,000 inhabitants. In the years up to 1967, car ownership, albeit unsteady, at least followed the same trend as the GDP per capita. However, the trends behaved completely independently to 1972. From that year to the present, motorization picks up very quickly.

Total vehicle registration is a cumulative measure of all vehicles ever registered up to a certain date and therefore neither indicates available passenger cars nor necessarily links to GDP. A more adequate parameter for correlating with GDP per capita is the number of new registrations per 1,000 inhabitants a year. Using a scraping rate of 6 percent per year for passenger cars, the new registrations in year t-1 can be calculated by:

$$\text{New Registration}_{t-1} = \text{Total Registration} - \text{Total Registration}_{t-1} + 0.06\ \text{Total Registration}_{t-1}$$

The resulting data are shown in Table 3.3-2 and Figure 3.3-2. From them it can be seen that the new registrations of vehicles have followed a very unsteady trend, especially before 1971. If the curve is smoothed by calculating the moving averages over three years, however, a similarity of shape with the curve of GDP per capita can be observed, particularly after 1971.

In fact, regressing the smoothed new registrations per 1,000 inhabitants against the GDP per capita (in 1975 prices) for 1971-1977 gives a correlation of 0.98 and an elasticity of 4.16. For the years 1965-1970 a cross-section regression linking the 1979 GDP per capita in the 13 Mohafazat and their motorization indices, based on total registrations, confirms the presently very high elasticity of car ownership to GDP per capita: value of 4.53 is obtained. If, however, the development of the very last years is considered, it can be seen that the elasticity, although always much higher than 1, is declining. The elasticity is 4.16 for the period 1971-1978 but is only 2.87 for 1975-1978 and 2.60 for 1977-1978. It is obvious that in the years after 1973, when import restrictions on passenger cars were relaxed or withdrawn, a huge suppressed demand for passenger cars was released; this demand is declining, however.

Table 3.3-2

PASSENGER CAR REGISTRATION, 1963 - 1978

Year	Total[1]	New	New per 1000 Inhabitants	GDP/Capita 1975 private
1963	18,900	4,130	0.821	1,540
1964	21,900	1,410	0.271	1,630
1965	22,000	620	0.116	1,610
1966	21,300	2,680	0.484	1,520
1967	22,700	360	0.061	1,550
1968	21,700	2,000	0.328	1,560
1969	22,400	2,640	0.433	1,750
1970	23,700	1,520	0.241	1,730
1971	23,800	820	0.126	1,840
1972	23,200	3,890	0.576	1,940
1973	25,700	3.040	0.435	2,130
1974	27,200	12,530	1.732	2,316
1975	38,100	14,190	1.732	2,770
1976	50,000	9,100	1.174	2,890
1977	56,100	8,170	1.014	2,720
1978	60,900			2,860

Source: Consultants calculations based on official registration data.

[1] 1963 - 1967 estimated: official figures include taxis.

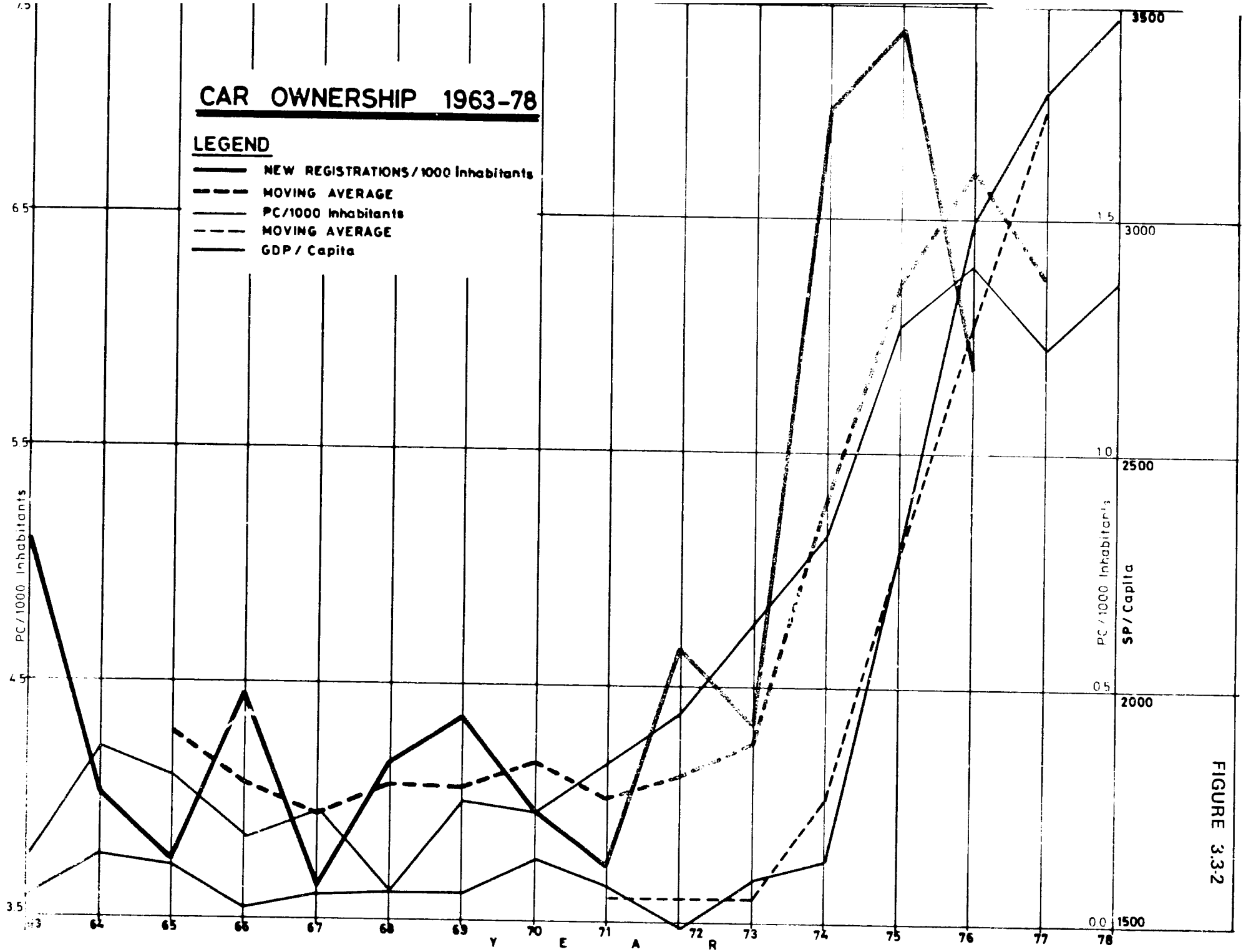
CAR OWNERSHIP 1963-78
LEGEND
NEW REGISTRATIONS / 1000 Inhabitants
MOVING AVERAGE
PC/1000 Inhabitants
MOVING AVERAGE
GDP / Capita
PC/1000 Inhabitants
PC / 1000 Inhabitants
SP / Capita
6.5
5.5
4.5
3.5
1.5
1.0
0.5
0.0
3500
3000
2500
2000
1500
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
Y E A R

FIGURE 3.3-2

For the forecast it was assumed that the elasticity would decrease linearly from 2.60 in 1978 to 1.50 in 2000. Having an elasticity constantly higher than 1 means that a growing portion of the disposable income will flow into purchase of passenger cars. This is an acceptable assumption if the present low level of motorization is considered, and if it is thought that the assembly of passenger cars in Syria will help relieve the foreign exchange problems deriving from high car imports.

If the relative real cost of private car travel remains unchanged, the total registrations of private cars will be 653,000 in 2000, an increase of 11.4 percent per year. This corresponds to an index of 37 passenger cars per 1,000 inhabitants.

To calculate the running fleet, it was assumed that, with an increasing fleet, the scraping rate of vehicles would also increase; that is, the average life of vehicles would decrease from the present 16 to approximately 10 years. The running fleets thus calculated would grow at an average of 9.4 percent per year and would correspond to a motorization index of 9.4 vehicles per 1,000 inhabitants in 1985 and 20.8 in 2000. (See Table 3.3-3 and Figure 3.3-3.)

The average income elasticities found for 1985 and 2000 were also used to regionalize the passenger car vehicle fleets by Mantika, using the GDP per capita derived from the Consultants' macroeconomic model. The resulting passenger car per 1,000 inhabitants indices refer to the privately owned running fleet and are not therefore directly comparable to 1978 figures. They are shown in Table 3.3-4.

Bus Frequency

As previously stated, the frequency of microbus and bus service is presently ruled by the number of licences issued to operators for a certain line. Although service is roughly demand oriented, the number of licences issued is not strictly aimed at the provision of a certain standard of service to users.

The present pattern of different service quality, different load factors, and different revenues for operators cannot be taken as a basis for forecasting the future. Considering the growing demand for bus transport, no presently granted licences need to be revoked, only transferred to another line. In addition to this, if a consistent tariff system is introduced, all routes should be equally attractive to operators, provided there are adequate load factors. For these reasons a demand-dependent model for determining the frequency of microbuses and

Table 3.3-3

PRIVATE CAR FLEET IN SYRIA, 1978 - 2000

Year	Elasticity	Percent Increase in New Registrations/ 1000 Inhabitants	New Registrations 1,000,000 Inhabitants	New Registrations (000)	Total Registrations (000)	Scrapping Rate Percent	Running Fleet (000)
1978	2.60	7.64	984	8.2	60.9	6.0	
1979	2.55	7.50	1,059	9.1	69.1	6.2	54.8
1980	2.50	7.35	1,137	10.1	78.2	6.4	60.7
1981	2.45	7.20	1,219	11.2	88.3	6.6	67.2
1982	2.40	7.06	1,305	12.5	99.6	6.8	74.3
1983	2.35	6.91	1,395	13.8	112.0	7.0	82.0
1984	2.30	6.76	1,489	15.3	125.8	7.2	90.5
1985	2.25	6.62	1,588	16.9	141.1	7.4	94.7
1986	2.20	6.53	1,691	18.6	158.0	7.6	109.7
1987	2.15	6.39	1,799	20.5	176.6	7.8	120.6
1988	2.10	6.24	1,912	22.6	197.1	8.0	132.4
1989	2.05	6.09	2,028	24.8	219.7	8.2	145.1
1990	2.00	5.94	2,148	27.2	244.5	8.4	158.9
1991	1.95	5.79	2,273	29.7	271.7	8.6	173.8
1992	1.90	5.64	2,401	32.4	301.4	8.8	189.7
1993	1.85	5.49	2,533	35.3	333.8	9.0	206.8
1994	1.80	5.35	2,668	38.4	369.1	9.2	224.7

Table 3.3-3 (Continued)

PRIVATE CAR FLEET IN SYRIA, 1978 - 2000

Year	Elasticity	Percent Increase in New Registrations/ 1000 Inhabitants	New Registrations 1,000,000 Inhabitants	New Registrations (000)	Total Registrations (000)	Scrapping Rate Percent	Running Fleet (000)
1995	1.75	5.20	2,807	41.8	407.6	9.4	244.2
1996	1.70	5.50	2,949	45.2	449.4	9.6	265.0
1997	1.65	4.90	3,093	48.9	494.6	9.8	287.0
1998	1.60	4.75	3,240	52.8	543.5	10.0	310.3
1999	1.55	4.60	3,389	57.0	596.3	10.2	335.0
2000	1.50	4.46	3,541	61.0	653.3	10.4	360.9

Source: Consultants' calculations.

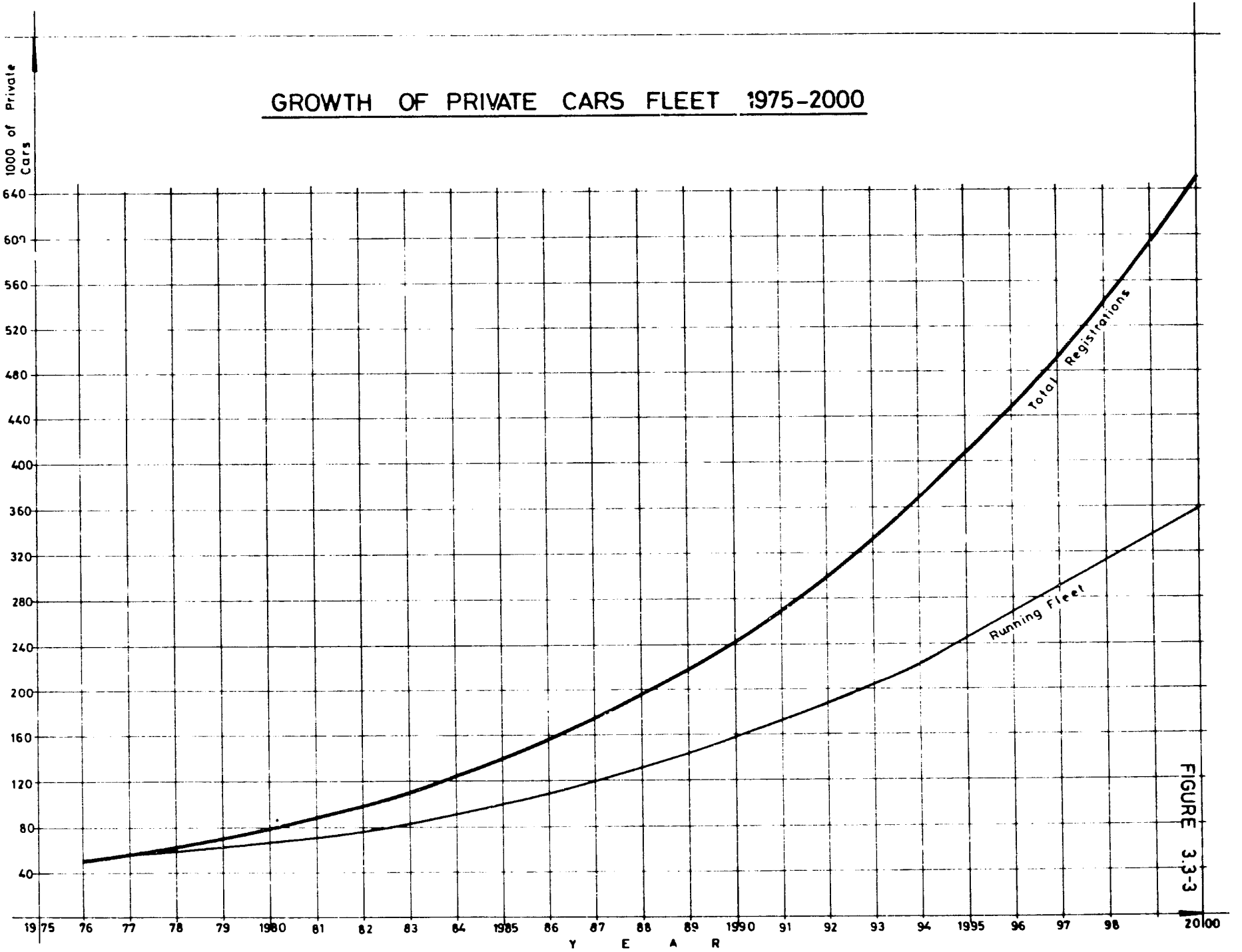
GROWTH OF PRIVATE CARS FLEET 1975-2000
1000 of Private Cars
640
600
560
520
480
440
400
360
320
280
240
200
160
120
80
40
1975
76
77
78
79
1980
81
82
83
84
1985
86
87
88
89
1990
91
92
93
94
1995
96
97
98
2000
Y E A R
Total Registrations
Running Fleet

FIGURE 3.3-3

Table 3.3-4

AVAILABILITY OF PASSENGER CARS PER 1000 INHABITANTS, 1985-2000

Mantika	1985	2000	Mantika	1985	2000
Damascus City	14.14	28.87	Safita	4.25	9.97
Douma	6.80	15.87	Cheich-Badr	3.19	8.09
Tal	8.36	18.74	Dreikish	3.97	9.40
Zabadani	6.36	14.89	Lattakia	10.95	23.18
Qatana	6.80	15.80	Djableh	5.49	12.95
Qouteifeh	5.50	12.18	Al Hiffeh	3.64	8.94
Nabek	9.02	19.93	Qirdaha	4.00	4.42
Darayya	10.60	22.79	Idleb	7.06	15.82
Yabroud	3.50	7.74	Ariha	5.19	12.13
Quneitra	5.69	13.89	Jisr-Al-Shughour	6.28	14.29
Fiq	-	7.68	Harem	3.76	9.13
Izra'	3.64	9.13	Ma'arrat Al-Nuo'man	5.70	13.24
Dera'a	6.55	15.62	Jabal Sam'an	14.34	29.56
Shahba	4.75	10.75	Isas	4.93	12.64
Salkhad	4.76	10.65	Al Bab	7.19	17.50
Al Suweida	8.20	18.61	Garablus	4.55	10.70
Tadmur	10.92	23.71	Ifrin	4.21	10.92
Tal-Kalakh	4.09	9.83	Ain Al Arab	4.29	10.44
Al Rastan	5.40	11.94	Manbedj	5.53	14.03
Al Quseir	5.76	13.14	As Sifa	3.03	7.80
Al Mouharram	4.48	9.59	Tal Abiad	4.04	9.81
Homs	12.27	26.23	Al Raqqa	7.88	18.81
Al Salamieh	7.83	17.46	Albu Kamal	5.73	14.18
Al Ghab	3.82	9.22	Al Mayadin	5.25	13.11
Missiaf	4.24	9.81	Deir Ez Zor	8.99	20.67
Mhardeh	3.04	7.99	Al Hassakeh	6.50	15.94
Hama	12.01	25.09	Ras Al Ain	4.79	17.92
Banias	5.39	12.92	Al Kamishli	7.44	17.92
Tartous	7.50	17.09	Al Malkieh	4.34	10.84

Source: Consultants' calculations.

buses was designed and is explained here. This model is based on the assumption that the frequencies thus calculated are, however, valid for scheduled service as well.

The starting datum for the determination of the frequencies is the total traffic demand in passenger trips per day between a certain origin and a certain destination. First the shares of private car, pickup, and railway passengers are determined based on the previously described methods. The remaining traffic flow (TRA) represents the total daily demand for passenger trips by taxi, microbus, and bus. This demand is considered to be distributed almost equally over the 14 hours period from 6.00 to 20.00. Four different ranges of traffic levels are considered.

Extremely low traffic demand: $0 < TRA \leq 280$ pax trips/day

If direct service between an origin and destination were to be run only with microbuses with a capacity of 20 passengers, only up to 14 bus trips a day would be operated. That is, the average headway would be one hour or more. Under these circumstances 30 to 40 percent of the passengers would switch to taxis or prefer to go to the nearest major center - say Mohafaza center - and there transfer to a direct bus bound to the final destination. It is assumed, and confirmed by the traffic figures, that the sum of all O & D pairs originating in a Mantika with demand less than 280 plus the direct flows to the nearest center always exceed 400 passenger trips per day and that therefore a minimum frequency of service of 10 microbuses and 2 buses a day is granted.

Thus, for O & D flows less than 280 passenger trips per day, it is assumed that at least one bus an hour is available although not directly bound to the final destination.

Low traffic demand: $280 < TRA \leq 560$ pax trips/day

Once the traffic is high enough to justify at least one microbus per hour, it is assumed that users would prefer the direct connection. With a headway of one hour, the average waiting time would be an acceptable 30 minutes. It would obviously be less in the peak and more in the off-peak hours. For these traffic volumes it would be wrong to use anything other than microbuses; if large buses were to be used, either local factor would be too low or their average headway would be more than one hour, and users would again rather use taxis or indirect connections. So it is assumed that, in this range of traffic demand values, the service is insured only by microbuses, the frequency of which increases linearly with the traffic. For the upper value of the range (28 bus trips per day), there is one trip every 30 minutes and an average waiting time of 15 minutes.

Intermediate traffic demand: 560 < TRA $\leq$ 2,800 pax trips/day

For total traffic demand higher than 560 passenger trips per day, it is possible to increase the total frequency offered to users and at the same time to use larger vehicles. For demand values near to 560 passenger trips per day, few large buses will be used only in the peak hour, and the rest of the traffic will still be taken over by microbuses. At the upper end of the range (2,800 pax trips/day), by using only large buses with a capacity of 50 seats, an average frequency of 56 buses every 14 hours, 4 buses per hour, or 1 bus every 15 minutes is reached, and no microbuses are needed.

High traffic demand: TRA > 2,800 pax trips/day

It is therefore assumed that the microbus frequency decreases linearly from 28 bus trips per day at 560 passenger trips per day, to 0 at 2,800 passenger trips per day, while the bus frequency increases from 0 to 56 trips per day. The total bus and microbus frequency thus increases linearly with the demand from 28 per day at the lower end to 56 per day at the upper end of the range.

For high and very high traffic demand, the service is efficiently taken over by large buses only, and their frequency increases linearly with demand. For demand higher than 4,200 passenger trips per day, an almost continuous bus service (one every 10 minutes) is available to users. A graph of bus frequency as a function of demand is presented in Figure 3.3-4.

All the above considerations pertain to the ideal case where the whole Mantika-to-Mantika demand for transport actually takes place between Mantika center and Mantika center While this is certainly nearly correct for long-distance trips, the closer the Mantika centers, the higher the likeliness that a considerable amount of demand moves between peripheral locations of both Manatik. S h a peripheral demand could, in some cases, be high enough to justify a direct service between non-Mantika centers. From a sample analysis it was determined that the share of demand with one end not in the Mantika center decreases very rapidly with the distance and becomes virtually nil beyond 300 kilometers. A parabolic of the fifth degree:

$$\underset{[\text{percent}]}{\text{Share of peripheral demand}} = 100 - 32\ \underset{[\text{kilometers}]}{\text{distance}}^{0.2}$$

adequately describes the situation (see Figure 3.3-5).

Therefore, every O & D pair was divided into one direct and one peripheral flow based on distance. The frequencies of microbuses and large buses were determined for each of those flows separately and then added.

One final observation is that the whole determination of bus frequencies is based on bus capacity considerations (one bus is supposed to leave when it is 100 percent full). The modal split process, as it has been described, subtracts the taxi share from the total demand and then splits the passengers between buses and microbuses. If used with reasonable assumptions about tariffs, this system always yields high load factors. This is a desirable situation because it makes bus service attractive to operators and guarantees an efficient use of vehicles, personnel, and fuel while still providing an excellent service to users.

Tariffs

The present tariffs for taxis, buses, and rail do not follow a system for the whole country and are often arbitrary and not market oriented. At any rate, they are largely lower than the marginal operating costs for all modes; not infrequently, they are even lower than the out-of-pocket costs. Under these circumstances, it is possible to keep the passenger transport system working only by means of large direct subsidies to cover railway operating losses or by indirect public transport subsidies (mainly through the artificially low diesel prices). There is frequent overcharging by taxis, and operators frequently are not aware of the actual operating costs of their vehicles. Less than optimal maintenance, extremely old vehicles, and overloading are also partly consequences of the low tariff level.

Bus tariffs were sizeably increased in 1980, but costs increased at least as much (wages grew by 60 percent, for example). The average tariffs in piasters per passenger-kilometer in 1979 were:

Taxi	Microbus	Bus	Rail
4.70	3.30	1.80	2.93

The average economic marginal operating costs in piasters per passenger-kilometer in 1980 were:

Taxi	Microbus	Bus	Rail
12.78	6.75	5.59	6.08

(Occupancies of 4, 13, and 40 passengers per vehicle were assumed for taxis, microbuses, and buses, and 400 passengers per train were used for rail.)

To compare the figures, the 1979 tariffs were inflated by the general price index (1.10 in 1980) and therefore became:

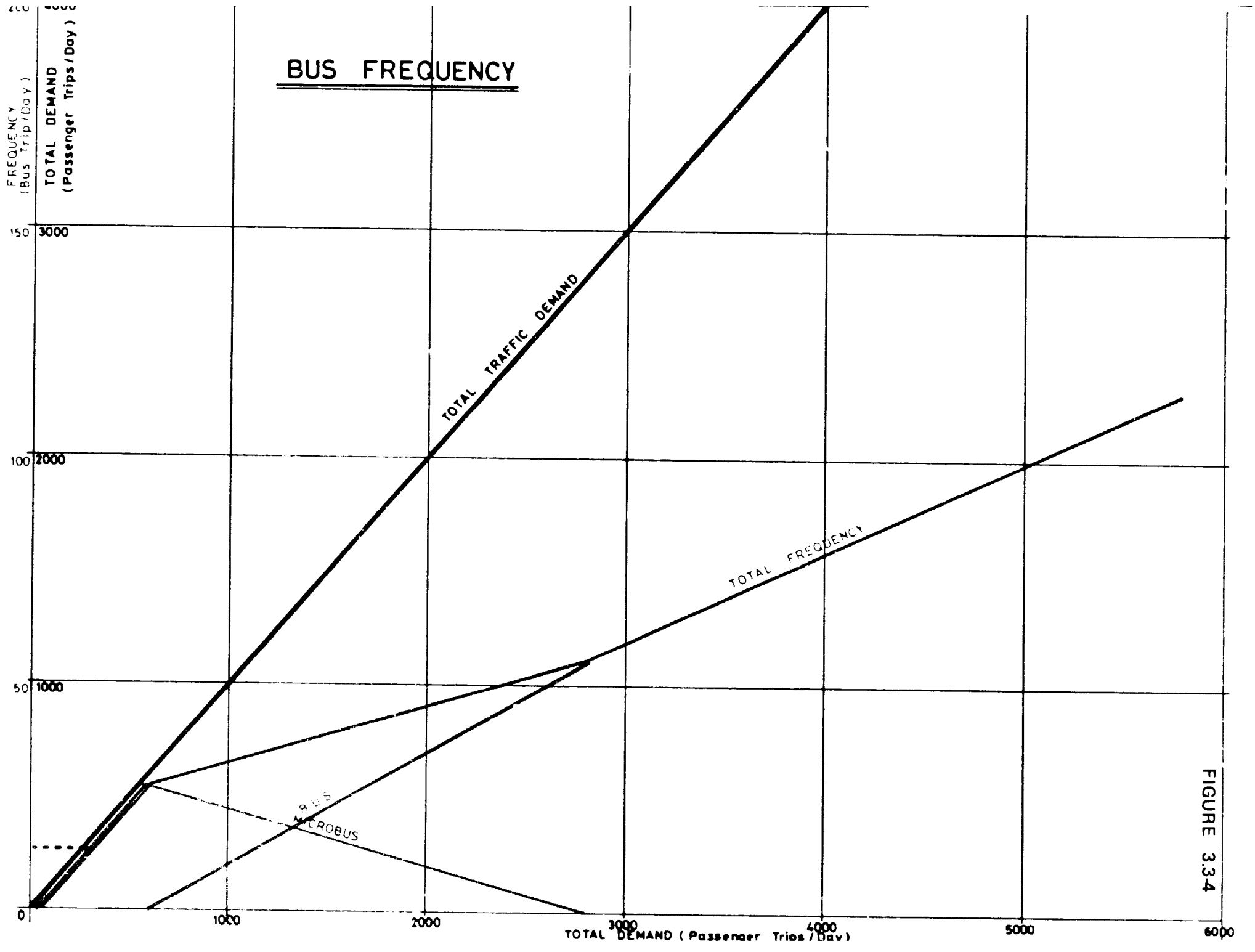
BUS FREQUENCY
FREQUENCY (Bus Trip/Day)
TOTAL DEMAND (Passenger Trips/Day)
150
100
50
0
3000
2000
1000
TOTAL TRAFFIC DEMAND
TOTAL FREQUENCY
BUS
MICROBUS
1000
2000
3000
4000
5000
6000
TOTAL DEMAND (Passenger Trips/Day)

FIGURE 3.3.4

SHARES OF DIRECT AND PERIPHERAL TRANSPORT DEMAND

$(Y = 32 x^{0.2})$

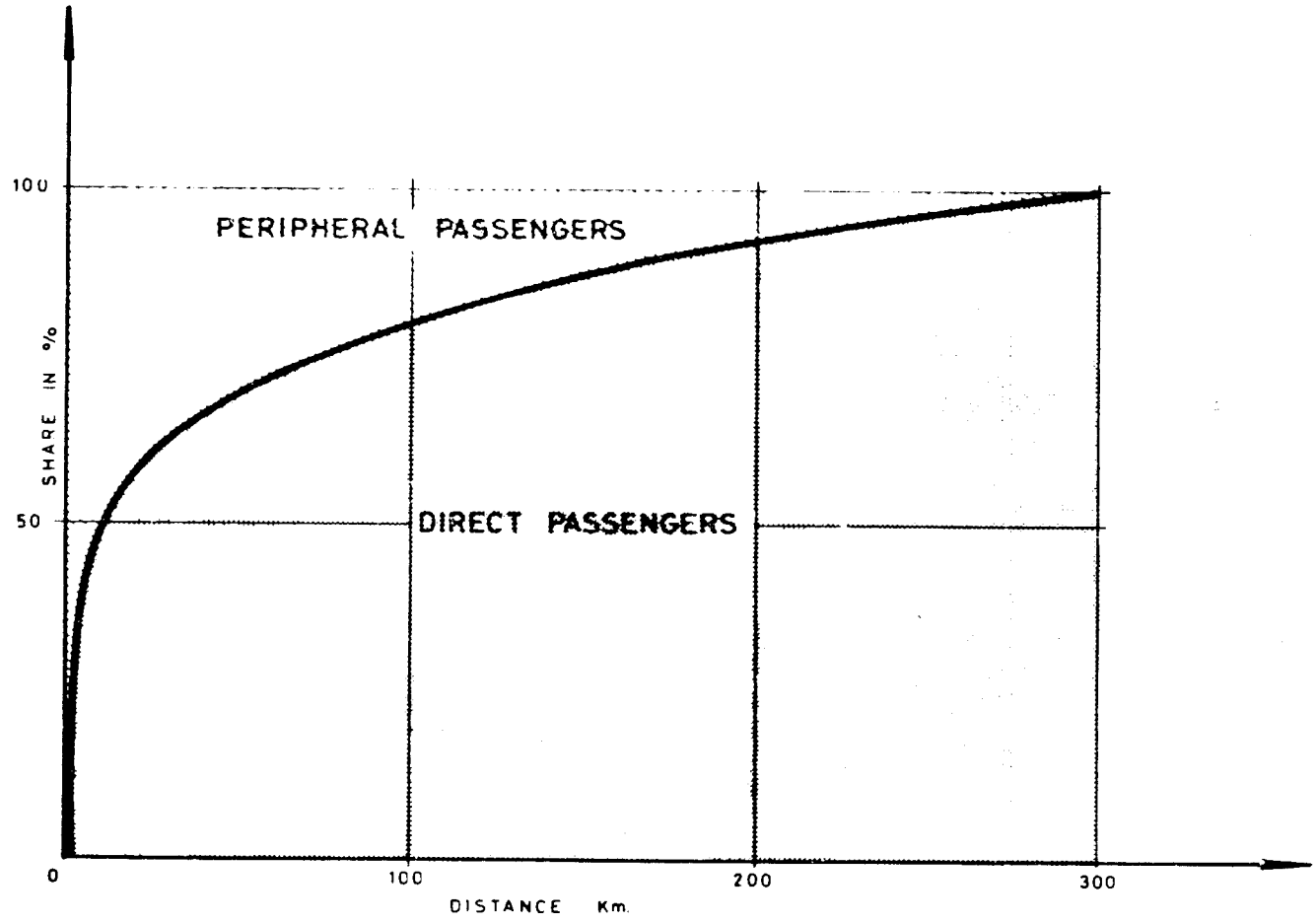

FIGURE 3.3-5

Taxi	Microbus	Bus	Rail
5.17	3.63	1.98	3.22

It can be seen that only the following percentages of economic marginal costs are covered by direct revenues:

Taxi	Microbus	Bus	Rail
40.5 percent	53.8 percent	35.4 percent	53.0 percent

This shows that not only is the general level of tariffs very low but also that competition is somehow distorted as large buses (and taxis) are compelled to run considerably higher deficits than other types of public services.

It was assumed that tariffs for passengers will be raised in the future in any case. One reason for this assumption is that it will be more and more difficult to convince operators to operate way below the break-even point. It is estimated that if the state would subsidize the whole operating deficit of passenger transport within Syria, such subsidies would reach approximately SP 1.7 billion per year by the year 2000, of which SP 900 million would be for the large buses alone. The regular subsidies to passenger transport would then amount to about 20 percent of the GDP of the transport and communications sector (or 1.5 percent of total GDP).

Therefore, a base situation was taken in which all passenger tariffs increase at a 2 percent per year rate in real terms.

The necessary subsides would still be a significant SP 800 million per year by 2000, but the proportion to GDP of the transport sector (9 percent) seems more acceptable.

For this case (called case A) all tariffs were made to increase by 2 percent per year, thus keeping the 1979 ratios among the tariffs of the different modes. However, it was assumed that the nationwide pattern of tariffs would be more consistent in the future than it is now. It was therefore assumed that tariffs would be linear (constant passenger-kilometer rate regardless of travel distance) and the same all over the country for taxis, microbuses, and buses.

There are two good reasons for such a tariff system. First of all, by allowing the operators to charge the same passenger-kilometer rates all over the country, all routes are made equally attractive, and this is the best basis for expecting that all licensed trips will actually be undertaken. It must be considered that taxi, microbus, and bus operators are small

operators, mostly owning just one vehicle. It cannot be expected that they compensate losses on one line with higher earnings on another one. Second, in the long run, the uniformity of tariffs encourages a rational distribution of dwellings and economic activities in the country. When tariffs on some routes are kept artificially low, a densening of activities along these routes is encouraged. If this is sometimes desirable in the short term, it certainly causes problems when the tariffs are increased.

Things are different for the railway. The CFS is a large state-owned company which can easily adjust its tariff system to suit the needs of transport planning. These needs are obviously to increase the share of railway passengers per se, in consideration of the large amount of money already invested and of the presently extremely low traffic-to-capacity ratio and particularly the share of long-distance railway passengers. To encourage the use of the railway, particularly by long-distance passengers, tariff schedules markedly tapered with distance are commonly used by railways all over the world. For this study a tapered tariff was developed which aims at strongly discouraging rail travel for lengths less than 100 kilometers. For this kind of commuter-like traffic, heavy investments in infrastructure, control systems, and rolling stock would be required. The distance range where high railway shares are desirable to help decongest the road system starts at around 200 kilometers (that is, the distance for some very heavy intercity movements such as Aleppo-Lattakia and Damascus-Homs). For very long journeys, say, longer than 450 to 500 kilometers, the time advantages of railway get so sizeable that no further major decrease of the rate is necessary to attract passengers to the railway. The tariff schedule must obviously be designed in such a way that a desired average revenue per passenger kilometer is attained. The resulting tariff schedule shows quite high rates for distances up to 100 kilometers then decreases very rapidly up to around 300 kilometers and then slowly up to 1,000 kilometers. The per-kilometer rate could be calculated from a mathematical function representing a curve. For the sake of having easy-to-calculate tariffs, it is usual to segment the tariff curve into constant rates for groups of 100 kilometers. The results are shown in Table 3.3-5 and Figure 3.3-6.

If a comparison is made with 1979 tariffs, it can be seen that the proposed tariffs are comparable to those on the Aleppo-Lattakia line. Aleppo-Lattakia was SP 8.00 in 1979 and is approximately SP 7.75 and SP 8.25 in the two alternatives for 1985. The proposed tariffs are much higher than those on other lines which were established years ago and never raised (e.g., Aleppo-Hassakeh 1979: SP 10.00; proposed: approximately 16.10 or 17.10 in 1985).

Table 3.3-5

PROPOSED PASSENGER RAILWAY TARIFFS

(2nd Class-Adult)

			Total Tariff (SP 1980)			
			2 percent case		Marginal Cost Case	
Distance Kilometer	Incremental rate (average rate = 100)	Actual rate (average rate = 100)	1985	2000	1985	2000
1-100	115.3	115.3	4.20	5.65	4.45	7.05
101-200	96.6	106.0	7.70	10.35	8.20	12.90
201-300	79.7	97.2	10.60	14.25	11.25	17.75
301-400	63.6	88.7	12.90	17.35	13.70	21.60
401-500	55.9	82.1	14.90	20.05	15.85	25.00
501-600	48.3	76.5	16.65	22.40	17.70	27.90
601-700	45.8	72.1	18.30	24.60	19.45	30.65
701-800	43.2	68.5	19.90	26.75	21.20	33.35
801=900	40.7	65.4	21.35	28.70	22.70	35.75
901-1000	39.0	62.8	22.80	30.65	24.25	38.20
> 1000	37.3	60.5				

Source: Consultants' estimates.

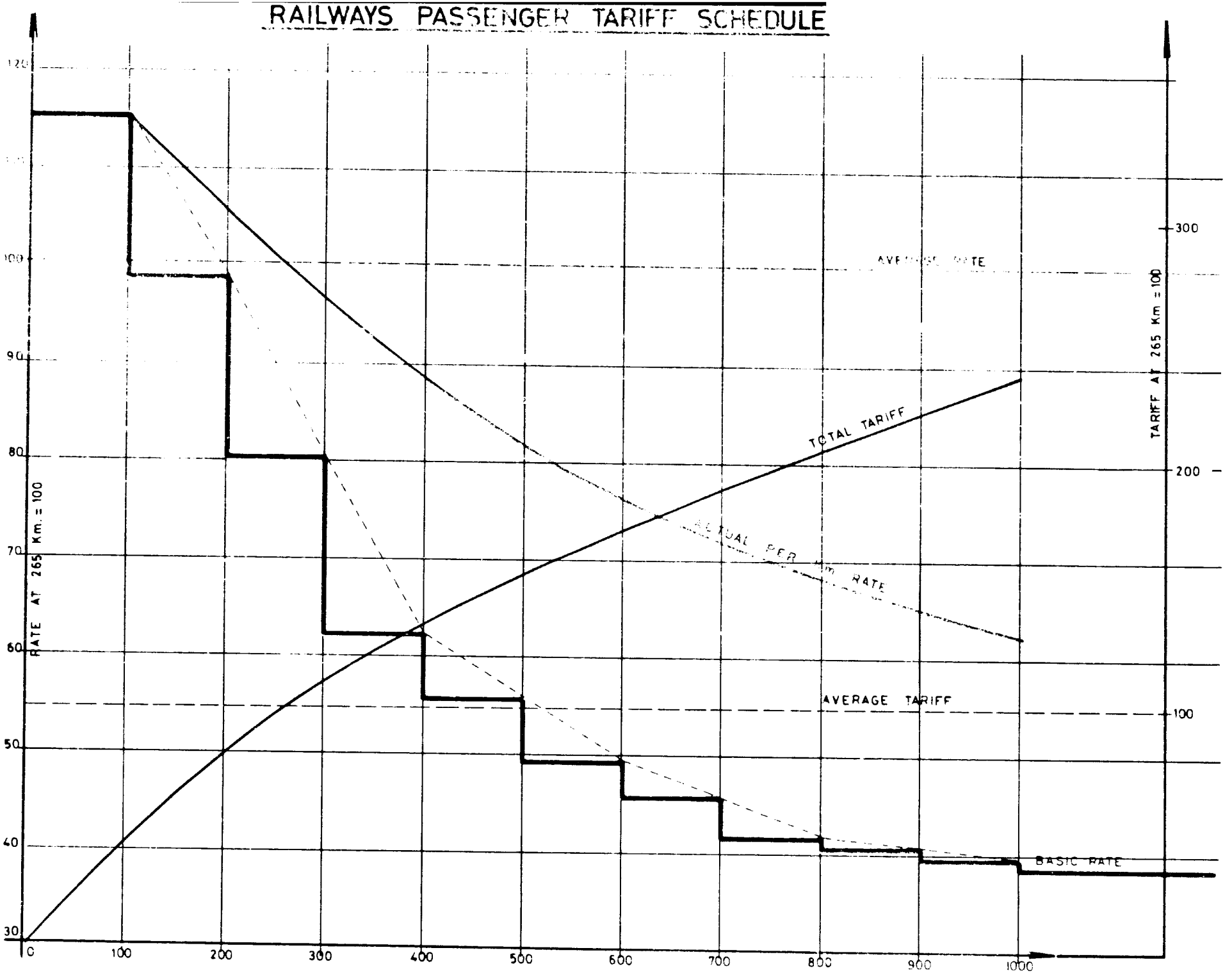
RAILWAYS PASSENGER TARIFF SCHEDULE
RATE AT 265 Km. = 100
TARIFF AT 265 Km = 100
120
100
90
80
70
60
50
40
30
300
200
100
0
100
200
300
400
500
600
700
800
900
1000
TOTAL TARIFF
AVERAGE TARIFF
BASIC RATE

FIGURE 3.3-6

The tariffs shown must be considered as indicative, as they are expressed in 1980 prices. The actual tariffs should be adjusted by the general price index, and rounding of the resulting amounts will make the ticketing operations easier, although rounding to full Syrian pounds as it is done now introduces considerable bias (for long distances one can travel 100 kilometers per one Syrian pound).

The other case analyzed for tariffs is the marginal cost case (called case B). In this case it is assumed that the long-run policy of the state would be to have a self-sustaining passenger transport sector by the year 2000. In other words, that by 2000 no direct or indirect operating subsidies would be paid to the passenger transport sector. This implies that the total revenues are sufficient to cover all operating expenses plus the depreciation of vehicles of rolling stock. The costs for building, improving, maintaining, and operating the infrastructure would not be covered by the revenues. The yearly growth rates of tariffs necessary to reach this goal would be:

Taxi	Microbus	Bus	Rail
4.4 percent	3.0 percent	5.1 percent	3.1 percent

This is higher than the 2 percent postulated in case A but still acceptable for users. A faster attainment of the financial balance would lead to tariff increases which, beside just not being feasible, also would induce a contraction in demand. In view of the high share of work and business trips, this is, in general terms, not desirable. Thus, for instance, if the tariffs have to equal marginal costs by 1985, yearly increases of 16.3 percent for taxis, 12.7 percent for microbuses, 18.9 percent for buses, and 11.2 percent for rail would be necessary. This would lead to a reduction in the per capita trip ratio to 97.8 percent of the present one, despite higher incomes. Total traffic would be just 80.2 percent of total traffic in case A. The increases of tariffs to reach marginal costs in 2000 also involve a contraction in demand if compared with the case A.

The elasticity of the per capita trip ratio to prices, which is very different for the different trip purposes, was taken to be -0.15 for work and business trips, -0.50 for tourism trips, and -0.60 for social trips. With the present trip purpose distribution of 75 percent work and business, 20 percent tourism, and 5 percent social, the elasticity in 1979 would be -0.24. With the considerable change in trip purpose mix assumed for 2000 (50 percent work, 15 percent tourism, and 35 percent social), the elasticity would then be -0.36. For 1985 it would be -0.27. The values used as an average for the two periods 1979-1985 and 1985-2000 are -0.26 and -0.33, respectively.

The weighted average for the tariff increase is 4 percent per passenger from 1974 to 2000, allowing for a 2 percent per year increase for relative prices of passenger car and pickup transport. As a consequence, if the GDP per capita were constant, the per capita trip ratio would decrease by 1.04 percent per year from 1979 to 1985 and 1.32 percent per year in 1985 to 2000. With the forecast increase of GDP per capita of 3.0 percent per year and the income elasticity of 1.22, the per capita trip ratio would increase by 2.6 percent per year from 1979 to 1985 and by 2.3 percent per year from 1985 to 2000.

Combined with the population increase, the traffic increase factor would finally be 1.455 from 1979 to 1985 and 2.588 from 1985 to 2000, an annual growth of 5.9 percent. In other words, compared with case A, total traffic would be 99.0 percent in 1985 and 87.9 percent in 2000.

For case B, the tapered railway tariff schedule shown in Table 3.3-5 was also kept. The per passenger-kilometer rates for taxis, microbuses, and buses in 1980 piasters are:

	1985		2000	
	Case A	Case B	Case A	Case B
Taxi	5.82	6.70	7.84	12.78
Microbus	4.09	4.33	5.50	6.75
Bus	2.23	2.66	3.00	5.59

3.3.4 Definition of Physical Alternatives

A number of permutations of physical road and rail networks were investigated, namely:

RD1 - Base road network: includes all roads existing, under construction, or committed for construction up to 1985 including the Damascus bypass.

RD2 - Maximum road network: includes the base network plus the Hama-Al Raqqa, the Tadmur-Albu Kamal roads, and the Aleppo bypass.

RL1 - Base rail network: includes all existing lines plus the Damascus-Homs, the new Homs-Aleppo, and the Aleppo-Albu Kamal lines. It includes neither the old nor the new Hijaz Railway in 1985 nor the new Hijaz Railway in 2000.

RL2 - Medium rail network: includes the base rail network plus the Tartous-Lattakia line.

RL3 - Maximum rail network: includes RL2 plus the Tadmur Albu Kamal line.

The following permutations were tested for the passenger modal split: all for case A and for case A and case B.

	RL1	RL2	RL3
RD1	1985, 2000	2000	2000
RD2		2000	

The basic input data calculated for each O & D pair for each of the investigated permutations were:

- distances for road and rail,
- travel times for road and rail,
- access distances for rail, and
- access lines for rail.

3.3.5 Results of the Modal Split Forecast

The passenger modal split model developed above was applied to 1985 and 2000. It should be noted that the model was applied only to domestic passengers. The modal split of passenger trips within and outside of the country was estimated approximately.

- 1985

The main results on a nationwide basis are shown in Table 3.3-6 and commented on in this section. The 1979 modal shares of passengers in percent were:

Passenger car - 9.5, Pickup - 6.8, Taxi - 20.6, Microbus and Bus - 6.3, Rail 1.8.

The first general comment is that the opening of the new railway line from Damascus to Aleppo will upgrade the Syrian railway from a number of lines to a closed system in which most important places can be reached by rail. This is promptly reflected by the more than doubling of the rail share from 1.8 percent of passengers in 1979 to 3.7 (Case A) or 3.8 (Case B) percent, and of the passenger-kilometers, 10.4 (Case A) or 11.1 (Case B) percent. For the other modes it can be seen that only marginal shifts in the shares occur.

Obviously the relative changes in tariffs over six years are not high enough to produce major changes in modal split. The high share of passenger-kilometers for the railway and its relatively high average trip distance reflect the effect of the

Table 3.3-6

1985 PASSENGER MODAL SPLIT ALTERNATIVES

PHYSICAL CASE: RD1 - RL1; TARIFF CASE A

	Passenger Car	Pickup	Taxi	Micro-bus	Bus	Rail	Total
Passengers per Day (000)	51.2	28.9	118.5	108.9	210.5	20.0	538.0
Percent	9.5	5.4	22.0	20.2	39.1	3.7	100.0
Passenger-Km per Year x 10^6	1.8	0.6	3.3	3.2	5.7	1.7	16.3
Percent	11.0	3.7	20.3	19.6	35.0	10.4	100.0
Average Trip Length (Km)	98	57	76	79	75	233	84
Total Revenues (SP x 10^6	-	-	191.2	128.7	129.8	64.6	514.3
Revenue per Passenger-Km (Piasters)	-	-	5.82	4.09	2.23	3.63	3.12

PHYSICAL CASE: RD1 - RL1; TARIFF CASE B

	Passenger Car	Pickup	Taxi	Micro-bus	Bus	Rail	Total
Passenger per day (000)	50.7	28.6	115.4	112.8	204.2	20.3	532.0
Percent	9.5	5.4	21.7	21.2	38.4	3.8	100.0
Passenger-Km per Year x 10^6	1.8	0.6	3.1	3.4	5.5	1.8	16.2
Percent	11.1	3.7	19.1	21.0	34.0	11.1	100.0
Average Trip Length (Km)	98	57	74	82	74	243	84
Total Revenues (SP) x 10^6	-	-	210.2	145.8	147.6	71.9	575.5
Revenue per Passenger-Km (Piasters)			6.70	4.33	2.66	3.86	3.52

Source: Consultants' estimates.

Note: Domestic passengers only.

tapered tariff system and the comparative advantage of railways over long distances. The split confirms that pickups are used mainly for short distances. Their average trip length is 70 percent of the overall average. The decrease of their share is certainly partly due to the previously mentioned imprecision in the definition of taxis and pickups in 1979.

The comparison of case A and case B does not show major differences in 1985. It may be noted, however, that in case B, the railway carries some more passengers, although the total traffic is 1 percent lower. Similarly, in case B microbuses divert some passengers from taxis. This shows on a small scale the effect of the marginal cost pricing system. The closer tariffs get to the natural tariffs, that is to the cost of transport, the less the penalization of the presently expensive modes: microbus and railway. The fact that the proportion between buses and microbuses changes slightly in the two cases can be attributed to the lower total traffic level in case B. As the large bus is optimally used only for large traffic flows, financially for the operators case B is obviously the better one. With 1 percent less traffic, 12 percent higher revenues are obtained.

- 2000

In base road, base rail network cases, the basic 2000 network of both road and rail stays unchanged from 1985 except for the opening of the new Hijaz Railway after 1985. This addition to the network is reflected by a slight increase in the rail share.

Since the main flow involved is Damascus-Dera'a, which is a distance of 130 kilometers, the average trip length on the railways decreases from 1985, and so does the passenger-kilometer share in case A. The increase in motorization is paralleled by an increase in the passenger car share. The reduction of the non-rail public transport share is mainly taken by the service taxis. The increase of total traffic increases the number of O & Ds which are optimally served by large buses rather than by microbuses. The proportion of microbuses, within a fairly constant share of all buses, therefore shows a marked decrease.

The undistorted tariffs of case B help achieve a better modal split. The shares of railways and of buses versus taxis are higher both for passengers and passenger-kilometers. The revenues in case B exceed those in case A by 38 percent, although total traffic is 17.1 percent lower.

The maximum road, medium rail network case analysis results are shown in Table 3.3-7. An increase in the railway share can be

Table 3.3-7

2000 PASSENGER MODAL SPLIT ALTERNATIVES

MAXIMUM ROAD, MEDIUM RAIL NETWORK

PHYSICAL CASE: RD2 - RL3, TARIFF CASE A

	Passenger Car	Pickup	Taxi	Micro-bus	Bus	Rail	Total
Passenger per Day (000)	227.6	70.7	198.7	81.1	686.6	66.0	1,330.7
Percent	17.1	5.3	14.9	6.1	51.6	5.0	100.0
Passenger-Km per Year x 10^6	8.1	1.5	5.4	2.4	19.4	4.9	41.7
Percent	19.4	3.6	12.9	5.8	46.5	11.8	100.0
Average Trip Length (km)	97	59	74	80	77	204	85
Total Revenues (SP) x 10^6	-	-	420.9	130.5	586.7	208.7	1,346.8
Revenue per Passenger-Km (Piasters)			7.84	5.50	3.30	4.97	3.28

PHYSICAL CASE: RD2 - RL2, TARIFF CASE B

	Passenger Car	Pickup	Taxi	Micro-bus	Bus	Rail	Total
Passengers per Day (000)	200.0	62.3	151.0	98.5	590.5	67.4	1,169.7
Percent	17.1	5.3	12.9	8.4	50.5	5.8	100.0
Passenger - Km per Year x 10^6	7.1	1.3	3.3	3.0	15.4	5.0	36.1
Percent	19.7	3.6	9.1	8.3	45.4	13.9	100.0
Average Trip Length (km)	97	59	60	84	77	203	85
Total Revenues (SP x 10^6	-	-	425.5	204.8	943.4	283.1	1,856.8
Revenue per Passenger-Km (Piasters)			12.78	6.75	5.59	6.24	5.12

Source: Consultants' estimates.

Note: Domestic passengers only.

observed between 1985 and 2000. The main reason for such an increase is obviously the opening of the railway line from Tartous to Lattakia, which diverts 10.3 percent of the public transport passengers between Damascus and Lattakia from the road to the rail in case A, and 10.7 percent in case B. A sizeable effect is also produced by the opening of the new Hijaz Railway, with high railway traffic being forecast for the Damascus-Dera'a flow. Also, the general increase in tariffs, by reducing the ratios between rail and bus tariffs, contributes to increases in the rail share. The fact that many medium-distance trips (like Damascus-Dera'a) use the railway causes a decrease in the average trip length on the railway; the share of passenger trips increases, as does the rail share of passenger-kilometers in case A between 1985 and 2000.

The most notable shifts of passengers occur among the road vehicles. First of all, as a logical consequence of the more than doubling of the availability of private cars, the passenger car share also almost doubles. As the share of pickup trucks does not change, the share of public road transport decreases from around 80 percent in 1985 to around 73 percent in 2000. The increase in tariffs (particularly in Case B), as well as the increased frequency of microbuses and buses, reduces the importance of intercity taxis, the share of which drops from more than 20 percent in 1985 to around 10 percent in 2000. The competitiveness of taxis is particularly affected for long-distance trips. The average trip length decreases from around 75 kilometers in 1985 to 60 kilometers in 2000 in case B.

The combined shares of microbuses and buses do not change much and fluctuate around 59 percent. The split between microbuses and large buses changes considerably though. Microbuses lose much of their importance and their share goes down from 20 to 21 percent in 1985 to 6 to 8 percent in 2000. The share of buses increases accordingly. The reason for this is obvious. The higher the traffic, the more O & D pairs that can be served by large buses without affecting the quality of service.

So the high-traffic O & D pairs among the major centers and between major centers and the surrounding Manatik are served almost exclusively by large buses. Microbuses are used mainly for the trips from and to medium-sized centers and for collecting passengers in minor Manatik and conveying them to the nearest major center. This is reflected by the slightly longer average trip length on microbuses.

As for the differences between case A and case B, what was said for 1985 is valid to a greater extent. The tariffs which are oriented on economic marginal costs encourage the use of the optimal modes. The rail share is thus higher compared to the rest of public transport, and the increased share of microbuses

in case B derives from the smaller total traffic figure (87.9 percent of case A). For a number of flows, the threshold value of traffic beyond which no more microbuses operate is not reached. From the financial viewpoint, it is obvious that case B is preferable: it has 87.9 percent of traffic, total revenues are higher by 37.4 percent than in case A, and the Government budget saves about SP 508 million of subsidies in 1980 Syrian pounds.

The maximum road, maximum rail network case is practically identical with RD2-RD1. The opening of the railway link to Albu Kamal from Tadmur does not affect any major intra-Syrian movement.

The final recommendation of one or another physical alternative or pricing principle will only issue from the calculation of total economic system costs. The analysis of the modal split forecast, however, leads to the preliminary conclusion that, regardless of the physical alternatives, the marginal cost pricing system seems preferable. The main reasons are:

- Transport users would pay for transport and no regular subsidies would be needed. Passenger transport is attractive for operators, and licenses are actually used. No distorting effects generated by artificially low tariffs are to be expected in the location of dwellings and economic activities.

- The fact of having tariffs based on economic costs encourages the use of the most economic modes. This is proven by the higher shares of microbuses versus taxis, and rail versus other modes in case B, when compared with case A.

The disadvantages of the marginal cost solution are mainly:

- Increasing tariffs is unpopular, although spreading the increase over 20 years leads to an acceptable annual rate of increase.

- The total traffic is less than in the other case (87.9 percent). The number of beneficiaries from investments in the transport sector would thus be smaller. The suppression of demand will mainly affect non-work trips, the share of which is expected to be 50 percent in 2000. Therefore, the loss to the economy would be minimal. On the other hand, a reduced number of passengers could prove beneficial, because of near-to-congestion traffic levels in the year 2000 on some links of the network. A slightly smaller growth of passenger traffic would help postpone extremely costly investments like double tracking or doubling of highways.

CHAPTER 4

PRELIMINARY INVESTMENT PRIORITIES

Chapter 4

PRELIMINARY INVESTMENT PRIORITIES

4.1 METHODOLOGY FOR ECONOMIC EVALUATION

The economic evaluation is the final stage in a project feasibility study. It is conducted after the project's annual costs and benefits have been calculated during a comprehensive project analysis. For projects that are system dependent, the economic benefits will be determined by the national transport model.

Five methods of present worth analysis were employed in the investigation. The net present value, benefit-cost ratio, and internal rate of return were used to establish project feasibility. Optimal timing of construction was determined by utilizing first-year benefit analyses or year-by-year postponement analyses where appropriate. These five methods of present worth analyses are described in detail in Volume VII, Section 3.1, of the Final Phase I Report.

Discount Rate

Experience in the determination of the opportunity costs of capital in many countries has been summarized by Hans A. Adler, the Assistant Director of the Economic Development Institute of the International Bank for Reconstruction and Development (IBRD) as follows: "The economic cost of capital is difficult to determine in the absence of free markets, especially since prevailing interest rates also reflect such factors as inflation and risk. However, it appears likely that the opportunity cost of capital in many developing countries is quite high, frequently as high as 12 percent or even more."[1] Mr. Adler's work was based upon the appraisal of a large number of transport projects in a broad range of developing countries. His conclusions seem both reasonable and relevant.

The examination of investment projects in Syria enables the country's preliminary positioning in relation to the 8 to 12 percent range discussed earlier. Syria has undoubtedly advanced beyond the state of extreme underdevelopment and provides an abundance of projects at relatively high economic rates of return. Most of the easy gains from fundamental development projects have already been realized. Therefore, the opportunity cost of capital would be within, and not above, the 8 to 12 percent range. It is also clear that Syria has not achieved the

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[1] Hans A. Adler, Economic Appraisal of Transport Projects (Indiana University Press, 1971), p.11.

level of development of the more advanced economies at the 8 to 9 percent range.

The logical elimination of the extremes above and at the lower end of the 8 to 12 percent typical range results in a fairly reliable order-of-magnitude for the opportunity cost of capital in Syria. In view of the level of economic development and the types and extent of planned projects, a discount rate in the 10 to 11 percent range would seem most realistic.

However, a final adjustment is necessary. The foregoing analysis was based on the extent of project execution specified in the 4th Five-Year Plan. Since the plan's completion, severe financial problems have developed. As a result, public sector investment expenditures have been restricted to on-going projects, and projects not yet begun have been postponed. The previously formulated discount rate must, therefore, be raised by perhaps 1 to 2 percent to reflect the increasing backlog of projects and the higher opportunity costs associated with the postponed projects. Consequently, 12 percent has been selected as the most realistic discount rate for project economic evaluation in this study. The sensitivity of a 6 percent discount rate was also tested. It did not alter the conclusions. (See Section 4.4.1 below.)

4.2 GENERAL

The evaluation of future transport requirements for the Syrian transport sector was carried out by developing alternative scenarios and comparing their likely consequences.

Alternatives for 1985 began with the identification of committed projects in the existing plans. The definition of committed projects is provided in Section III.B.2.b of the Terms of Reference (TOR). All projects currently under construction or for which financing has been received or guaranteed are defined as committed projects.

These committed projects are quite extensive. All of them are planned to be completed by 1985. Considering the necessary lead time for initiating a new major transport facility construction project, it was decided that the transport network to be analyzed for the year 1985 would consist of all existing facilities and all committed projects, plus two feasibile links integral to them.

For the year 2000 several additional transport links have been identified and alternative networks have been delineated. For the combined systems of rail and road transport, evaluation processes have been performed for each of the scenarios over the period from 1980 through 2020.

The economic effects of the alternative modal splits have been determined. Investment plans for the period 1981 through 1985 have been developed for each mode based on modal economic analyses within the framework of the preferred long-term alternative.

For the period 1986 through 2000, probable transport projects have been identified on the basis of projected traffic and the relative economic benefits determined in the preceding analyses.

It should be noted, however, that evaluation criteria applied in this chapter are strictly economic. They are not comprehensive since they exclude considerations of the political and social consequences of the development, some of which may be of greater significance in the long run.

Considerations of income redistribution effects of projects are also not included in this evaluation. For example, investment in highways by the Government to lower road transport costs without a supplementary increase in road user charges might result in the transfer of income from the general public to road transport vehicle operators. A similar phenomenon may result in development gains by different regions of the country. The Government may intentionally use transport investment to help achieve such objectives. Defining such objectives, however, is not within the scope of the Consultants' work.

Even in the purely economic sense, one cannot always follow theoretically ideal approaches in a practical study. An example of this is the shadow pricing or the opportunity cost of the resources used. Ideally, all resources would be valued at the cost to the economy by allocating the resource in question to a project from the other possible uses, in order that the economic evaluation criterion of total cost minimization or net benefit maximization reflects the true effect of a project on the economy. Only capital and fuel have been the subject of direct estimation of opportunity cost. The derivation of opportunity cost of capital is shown in Section 4.1 above.

A commodity which is currently sold in Syria at a price quite different from its true economic cost is diesel fuel. Instead of current market prices, unit costs derived from international market prices have been adopted to represent economic costs. These estimated economic costs are considered as the opportunity costs of fuel.

Market values have been used for all other items. All costs have been estimated using 1980 price levels.

4.3 ALTERNATIVE SCENARIOS FOR THE FUTURE

4.3.1 Alternative Rail Infrastructure

General

The railway network operating and investment assumptions used in the inter-modal analysis are described fully in Volume III, Chapter A-8. The network assumed to be in operation by 1985 consists of existing lines plus a new and reconstructed Aleppo-Damascus line, and the Deir Ez Zor-Albu Kamal line. No alternative rail network is considered for the period before 1986. For 2000 the Lattakia-Tartous and standard gauge Hijaz lines are included in the network.

The Consultants' assessment of rolling stock investment starts with the traffic projections and converts them into units required by assuming train sizes, load factors, and performance of a level felt to be attainable by CFS in the future. The longer-term requirement for line capacity improvements is similarly tied to the traffic projections, the critical factor being the number of trains per section. Expenditures from 1986 to 2000 have been determined consistent with alternatives A1 and B2 and are presented in Section 4.4.2. The basis for the operating cost estimates is presented in Volume III, Chapter A-8, Section A-8.5. All capital expenditures are given at average 1980 price levels, which are used throughout the study for inter-modal comparison purposes.

Rolling Stock

In order to determine the number of trains by line section, the passenger and freight flows were aggregated for each section and converted into trains using the following average loads:

	1979 Actual	1985	2000
Passengers (no.)	300[2]	400	600
Freight Net Tons			
Group A Commodities	-	500	600
Group B Commodities	250[3]	250	350
Group C Commodities	-	150	250
Phosphate	-	820	820

[2]Locomotive-hauled services.

[3]Ordinary freight services.

Trains per line have been rounded to the nearest even number per day. The average load for freight trains other than the phosphate trains works out at a little over 400 net tons for 1985 and about 500 tons for the medium and high cases in 2000.

The results of the analysis are given in Table 4.4-9, which shows the number of daily passenger and freight trains (disregarding the small number of railcar services) per section and overall annual train-kilometers. On the Damascus-Aleppo and Aleppo-Al Raqqa routes, volumes are large by 1985, with 30 daily trains over the Mhine-Homs section and 26 for Jibrine-Al Raqqa. In the Consultants' opinion, the Damascus-Aleppo line frequency and train mix justifies the provision of centralized traffic control (CTC) at the outset, with controllers in Aleppo, Homs, and Damascus.

To determine rolling stock requirements, the annual train-kilometers were converted into units using the following average annual kilometerages and numbers of vehicle-kilometers per train-kilometer:

	1979 Actual	1985	2000
Annual Vehicle-Kms (000)			
Mainline Locomotives:			
Passenger	55	120	120
Freight		100	100
Coaches/Baggage Cars	100[4]	120	120
Wagons	16	25	25
Vehicle-Km per Train-Km			
Mainline Locomotives:			
Passenger		1.05	1.05
Freight	1.12	1.20	1.20
Coaches/Baggage Cars	7.1	10.0	10.0
Wagons	17.6	20.0	25.0
Average Loaded Wagon Load Tons[5]	28.4	40.0	40.0

[4]Approximate due to large delivery of new coaches during the year.

[5]Including 50 percent empty running, overall average is half of tonnage shown.

The requirements for rolling stock in addition to those on order, assuming that all existing and new stock achieves the set efficiencies in use, are given in Table 4.3-1a. Replacement of existing stock is included in the figures after assumed lives of 25 years for mainline locomotives, 30 years for shunting locomotives and coaches, and 40 years for freight wagons. Because most existing stock is relatively new, replacement does not occur until late in the period and little is necessary before 2000. In total, 30 mainline locomotives, 10 shunting locomotives, and 200 freight wagons attain their assumed working lives by 2000.

The total cost for rolling stock in the 5th Plan, additional to stock already ordered which may be charged to the period, is estimated at SP 472 million (at 1980 prices) assuming unit costs of SP 3.7 million for a mainline locomotive, SP 2.3 million for a shunting locomotive, SP 0.58 million per coach, and SP 0.12 million per wagon.

Line Capacity

In calculating additional line capacity investments, the assumption has been made that the line capacities could be increased by 25 percent without double tracking through the use of intermediate block signalling, the lengthening of passing sidings, and the provision of additional stations on critical sections for an investment of 10 percent of the double tracking cost. This investment postpones double tracking by about five years. The cost of double tracking is assumed to be SP 1.9 million per kilometer.

Table 4.3-1a

ROLLING STOCK REQUIREMENTS TO 2000

	1981-85	1986-90	1991-95	1996-2000
Case A-1				
Mainline Locomotives	50	30	50	30
Shunting Locomotives	20	15	15	20
Coaches	200	200	200	100
Wagons	600	1,500	1,600	2,200
Case B-2				
Mainline Locomotvies	50	35	60	39
Shunting Locomotives	20	15	15	15
Coaches	300	210	215	118
Wagons	600	1,850	2,170	2,920

Source: Consultants' estimates.

4.3.2 Alternative Road Infrastructure

General

The Syrian paved road network has been greatly expanded in the past decade. Today virtually all administrative centers down to the Mantika center level are served by the 3,930 kilometer main paved road network, and other smaller villages are served by the 8,640 kilometer road network. In addition, a significant number of major highways are either under construction or construction is committed. The goal of providing high-quality road connections between major cities and points of traffic generation will largely be fulfilled by the time all of these projects are completed. As noted in Section 4.2 above, no additional independent road links are considered for 1985, and several new links are taken into account for 2000. However, a comprehensive highway betterment and maintenance program has been analyzed. The following describes such future road networks and programs.

1985 Network

In addition to the existing roads, the 1985 road network includes new highways and improved highways shown in Table 4.3-1. Costs of these projects are presented in Section 4.5 below.

Although only one set of road connections for the year 1985 has been considered, in the evaluation of alternatives, road surface conditions and road widths are different depending on the alternative. Two alternatives have been differentiated: one is based on the 1985 road connections without a highway betterment and maintenance program, and the second analyzes the same 1985 road connection with a highway betterment and maintenance program.

2000 Network

Given the well developed 1985 road network, one possible alternative for the year 2000 is to have no more additional highway links; in other words, apply the 1985 network up to the year 2000.

Another alternative network for the year 2000 has been developed and includes the following new highway links in addition to the 1985 network:

- Hama-Al Salamieh-Al Raqqa Highway (260 kms): Growing transport needs of the northeast region will be met by the improved rail operation, the Aleppo-Tal Kojak Highway, and the

Table 4.3-1

COMMITTED HIGHWAY PROJECTS TO BE COMPLETED BY 1985

Project	Distance (km)	Planned Completion
Additional carriageway, Ma'loula-Homs	105	1981
Resurfacing, Saraqueb-Aleppo	40 x 2	1981
Resurfacing, Homs-Hama	40 x 2	1981
Resurfacing, Ma'loula-Homs	105	1985
Resurfacing, Damascus-Maloula	50 x 2	1981
Autostrad, Damascus-Lebanese Border	40	1982
Diversion Road, Tal Kalakh	33	1981
Highway, Damascus-Jordanian Border	110	1983
Highway, Nasired- Quaryatein-Phosphate Mine	57	1981
Autostrad, Homs-Lobide	20	1980
Resurfacing, Damascus-Iraqi Border	215	1985
Highway, Tadmur-Deir Ez Zor	200	1981
Highway, Al Ghab-Ain Sharkieh-Djableh	50	1982
Highway, Akari-Tartous	48	1981
Resurfacing, Furglus-Phosphate Mine-Swani	123	1982
Highway, Aleppo-Tal Kojak	460	1983
Bypass, Hama	10	1982
Highway, Hazano-Idleb	20	1981
Bypass, Homs	20	1985
Widening & Resurfacing, Damascus-Dera'a	110	1980
Highway, Lattakia-Tartous	90	1985
Additional Carriageway, Hama-Saraqueb[1]	97	1985
Highway Spur, Tal Abiad	30	1985
Highway, Lattakia-Ariha[1]	100	1985
Damascus Bypass	22	1985

Source: 4th Five-Year Plan, State Planning Commission and interviews with Government officials.

[1] The additional carriageway Hama-Saraqueb and the Lattakia-Ariha highway are not committed under the TOR definition. However, both have been preliminarily found to be economically feasible.

Tadmur-Deir Ez Zor Highway, all to be put in service by 1985. But by the year 2000, this road link may become a necessity in order to relieve pressure on the Al Raqqa-Aleppo and the Aleppo-Hama Highways. It is reported that the Hama Mohafaza has already started constructing this link with its own crews. A link connecting this road and the Tadmur-Deir Ez Zor road in the mid-point is also included in the alternatives. This link would provide an almost straight-line road connection between Damascus and Al Raqqa.

- Aleppo Bypass (16.25 kms): Bypass roads around Homs and Hama are already committed for construction. A bypass road around Aleppo will likely be a necessity by the year 2000.

- Tadmur-Albu Kamal Highway (258 kms): If transit traffic to Iraq from Tartous or Beirut through Albu Kamal is large enough, cost savings by shortening the distance from Tadmur-Deir Ez Zor-Albu Kamal would justify this project.

Construction cost estimates for these links are shown in Table 4.3-2. Cases with or without the highway betterment and maintenance program have been treated as alternatives for 2000, the same as for 1985.

Highway Betterment and Maintenance Program

The basis for the highway betterment and maintenance program is presented in Volume IV, Chapter 3.

The Consultants essentially recommend the following:

- Improve the operational efficiency of highway maintenance by instituting an intensive training program. This should not only produce immediate benefits in the form of reduced vehicle operating costs but should also prevent highways from premature deterioration.

- Improve the physical properties of highways by resurfacing and/or widening them wherever and whenever economic benefits from such operations justify them.

The program recommends different standards to be applied to highways depending on traffic level. Key features of these standards are summarized in Table 4.3-3.

Costs of Highway Betterment and Maintenance

Financial and economic unit costs were developed for the highway betterment projects. They vary depending on the type of road, the terrain, and the region. Table 4.3-4 sumarizes the results.

Table 4.3-2

CONSTRUCTION COST ESTIMATES OF HIGHWAYS
INCLUDED IN ALTERNATIVE A2
(Cost in million SP at 1980 prices)

Highway	Kilometers	Financial Cost	Economic Cost
Hama-Al Salamieh-Al Raqqa	260	233	207
Aleppo Bypass	17	17	17
Tadmur-Albu Kamal	258	340	299

Source: Consultants' estimates.

Table 4.3-3

RECOMMENDED GEOMETRIC ROAD STANDARDS

Class	Y	X	A	B	C	D
Traffic Range in ADT	Over 30,000	9,000 to 30,000	5,000 to 9,000	1,500 to 5,000	400 to 1,500	Less than 400
Minimum Road Width (in meters)	21.9	14.6	7.3	6.7	6.2	3.5
Road Surface/Type	(Autostrad)	(Autostrad)	Asphaltic Concrete	Hot Mix	Single Bituminous Surface Treatment	Gravel

Source: Consultants' estimates.

Table 4.3-4

FINANCIAL AND ECONOMIC UNIT COSTS OF BETTERMENT
(SP per meter^2)

		X	A	B	C[1]	
Resurfacing	Financial	8.0	8.0	6.5	2.0	
	Economic	7.0	7.0	5.7	1.7	
Widening Flat Terrain	Financial	168	80	46	30	(38)
	Economic	140	66	38	24	
Rolling Terrain	Financial	173	93	60	41	(51)
	Economic	144	78	50	34	
Hilly Terrain	Financial	180	123	83	62	(74)
	Economic	148	103	70	52	
Mountainous Terrain	Financial	195	138	86	76	(79)
	Economic	162	115	71	63	

Source: Consultants' estimates.

[1] Widening costs for Class C roads in Al Suweida and Dera'a Mohafazat are shown in parentheses.

Maintenance costs were estimated as a function of the road type and the traffic volume. The resulting equations for the per kilometer annual maintenance costs are shown below:

- Asphaltic Concrete: $C = \underset{(2585)}{2900} + \underset{(0.31)}{0.34} + \underset{(603)}{678}\ LN\ \frac{T + 300}{100}$

- Hot Mix: $C = \underset{(2243)}{2520} + \underset{(0.41)}{0.45} + \underset{(603)}{678}\ LN\ \frac{T + 300}{100}$

- Bituminous Surface Treatment: $C = \underset{(1671)}{1898} + \underset{(0.99)}{1.13} + \underset{(603)}{678}\ LN\ \frac{T + 300}{100}$

(Where T is the ADT, LN is the logarithm, and C is the per-kilometer maintenance cost in Syrian pounds. Figures in parenthesis indicate the factors used for economic costs.)

Deterioration of Highways

Pavement surfaces deteriorate with time and the repeated movement of traffic over them. If surface conditions are measured on a scale of 1 through 9, without maintenance, a newly surfaced road with condition code 9 will eventually deteriorate to condition code 1. For the alternative, with a proper maintenance program, the following deterioration rates per year were assumed:

- for asphalt concrete surface

$$R = 5/(15.5 - 0.001\ ADT)$$

- for low type hot mix surface

$$R = 5/(9.94 - 0.0011\ ADT),\ \text{and}$$

- for bituminous surface treatment

$$R = 5/(7.56 - 0.0022\ ADT)$$

(Where R is the deterioration rate in points per year, and ADT is the average daily traffic.)

For the alternative without a proper maintenance program, it was assumed that the deterioration rates would be twice as high as those shown above.

It was also assumed for the alternatives without the proposed betterment/maintenance program that resurfacing would be applied when the surface condition reached the lowest grade.

4.3.3 Road Vehicle Fleet Investments

Investments for vehicles are not included in the transport sector of the five-year plan, and over 90 percent of the investments are made by the private sector. However, they are transport investments and represent a substantial foreign exchange cost. For these reasons the Consultants have forecast investment requirements for road vehicles through the year 2000. These forecast vehicle investment costs are included in the total investment requirements of each of the alternatives that are analyzed in Section 4.4 below, so that the least cost alternative is chosen on the basis of total cost to the economy and not merely public sector investment costs. Alternative vehicle requirements are shown in Table 4.3-9.

The estimation of future vehicle fleet requirements has been carried out as an integral part of the SYRTRANS modeling system. Vehicle utilization factors affecting the size of additional fleet were analyzed and are summarized in Section 1.2.3 of this volume.

Average costs of new vehicles have been estimated at 1980 prices for eight vehicle types and are shown in Table 4.3-5.

As explained above, no alternative road transport demand levels have been considered for the period up to 1985 on the grounds of the extensiveness of already committed infrastructure projects (road and rail) and the minor differences in the effect of alternative pricing schemes up to 1985.

The required vehicle fleet for the period 1981 to 1985 is shown in Table 4.3-6. To satisfy demand, the total vehicle fleet has to grow at a rate of 4 percent per annum. Passenger cars and the taxi fleet would grow at a rate double the total fleet average, whereas the microbus fleet may decrease as more efficient regular-size buses are brought in to replace microbuses as passenger demand increases. Results are summarized in Tables 4.3-7 and 4.3-8.

4.3.4 Alternative Infrastructure - Other Modes

Air

The future infrastructure requirements for air transportation have been specified largely on technical grounds rather than on a detailed study of alternative facilities. Safety and cost effectiveness are important criteria that were used so that while there may be alternative airport designs for domestic airports, for example, these were not studied in detail. Instead, a design known to be effective was selected that would be adequate to serve expected traffic. It should be kept in

mind that before actual projects are started, a detailed master plan for each site is considered essential.

With regard to navigational aids and safety equipment, international standards have been used and installations recommended to meet these standards.

In summary, the infrastructure for civil aviation that has been recommended includes the following major elements:

- Air Terminals

Damascus: Some minor modification to the new terminal building now under construction in the 1981-1985 period plus a terminal extension for international passengers and a separate domestic terminal after 1985. A number of ancillary facilities will also be required after 1985.

Aleppo: Modification of the existing terminal building and construction of a new international passenger terminal are recommended in the 1981-1985 period, and some extensions to terminal facilities after 1985 will be required. In addition, a few minor ancillary facilities are needed.

Other Airports - Lattakia, Deir Ez Zor, Al Kamishli, Palmyra: For Lattakia, modification of the existing terminal building plus a new control tower are recommended. At the other three airports a relatively simple common design air terminal is recommended. Again, some minor supporting infrastructure elements are required.

Al Hassakeh: Funds have been included in the 1980 budget for a feasibility study of the airport. However, preliminary analysis indicates that an airport at Al Hassakeh cannot be justified in the 1981-2000 time period on economic grounds. Al Hassakeh is only 85 road kilometers from Al Kamishli, and airports this close together would require a traffic demand well in excess of that forecast for the Al Kamishli-Al Hassakeh area in the year 2000. Moreover, the Consultants' estimates indicate that less than 10 percent of the forecast Damascus-Al Kamishli air traffic, and less than 25 percent of the total Al Kamishli traffic, is actually destined for the Al Hassakeh area.

Runways, Taxiways, and Aprons: All airports require some pavement work for either extending or improving existing pavements to allow them to handle new aircraft types. Much of this work is scheduled for the 1981-1985 period. Only Damascus and Aleppo have requirements after 1985.

Table 4.3-5

AVERAGE COSTS OF VEHICLE ACQUISITION

(SP 000)

	Vehicle Type							
	Passenger Car	Taxi	Pickup	Micro-bus	Regular Bus	2-axle Truck	3-axle Truck	Combination Truck
Economic	49.3	44.3	34.1	147.7	547.1	225.8	34.1	357.4
Financial	116.1	104.2	38.7	164.5	611.7	258.1	365.4	441.8

Source: Consultants' estimates

Table 4.3-6

ROAD VEHICLE FLEET REQUIREMENTS, 1981-1985

(in thousands)

Year	Pass. Car	Taxi	P/U	Micro-bus	Bus	2-axle Truck	3-axle Truck	Combination Truck	Total
1981	63.1	24.5	82.8	3.6	5.0	26.4	2.8	3.6	211.9
1982	67.6	26.5	83.7	3.5	5.1	27.1	2.9	3.8	220.3
1983	72.5	28.6	84.5	3.4	5.3	27.8	3.1	3.9	229.2
1984	77.7	31.0	85.4	3.3	5.4	28.6	3.2	4.1	238.7
1985	83.3	33.5	86.2	3.3	5.6	29.3	3.4	4.2	248.8
Annual Growth Rate in Percent over Period 1979-1985.									
	7.2	8.2	1.0	-2.3	3.0	2.6	5.3	3.6	4.0

Source: Consultants' estimates.

Table 4.3-7

REQUIRED ADDITIONAL VEHICLES, 1981 - 1985

(In thousands)

Year	VEHICLE TYPE								
	Passenger Car	Taxi	Pickup	Micro-Bus	Regular Bus	2-axle Trucks	3-axle Trucks	Combination Trucks	Total
1981	7.8	2.4	2.8	0.07	0.36	2.0	0.27	0.30	16.1
1982	8.3	2.6	2.8	0.07	0.36	2.0	0.20	0.31	17.0
1983	8.9	2.9	2.8	0.07	0.37	2.1	0.30	0.33	18.0
1984	9.6	3.4	2.9	0.07	0.38	2.1	0.31	0.34	19.0
1985	10.3	3.6	2.9	0.07	0.39	2.2	0.33	0.35	20.1
	44.9	14.9	14.2	0.35	1.85	10.4	1.49	1.65	90.2

Source: Consultants' estimates.

Table 4.3-8

VEHICLE FLEET INVESTMENT, 1981-1985

(In million SP)

	1981	1982	1983	1984	1985	Total
Economic	1,437	1,497	1,567	1,637	1,712	7,852
Financial	2,237	2,330	2,479	2,631	2,776	12,453

Source: Consultants' estimates.

Table 4.3-9

VEHICLE FLEET INVESTMENT, 1986-2000

(In million SP)

	ALTERNATIVE SCENARIOS				
Alternatives	A0	A1	A2	B2	B3
Pricing	Non-Marginal			Marginal Cost Pricing	
Rail Commodity Share	Low	Low	Low	High	High
Rail Network	Low	Medium	Medium	Medium	High
Road Network	Base	Base	High	Base	Base
1986-1990 Economic Costs	11,616	11,607	11,645	10,564	10,552
Financial Costs	18,861	18,853	18,906	16,992	16,978
1991-1995 Economic Costs	16,232	16,217	16,320	14,236	14,212
Financial Costs	27,369	27,362	27,498	23,785	23,758
1996-2000 Economic Costs	23,263	23,242	23,462	19,642	19,598
Financial Costs	40,641	40,641	40,929	34,030	33,980
Total Economic Costs	51,111	51,066	51,427	44,442	44,362
Total Financial Costs	86,871	86,856	87,333	74,807	74,716

Source: Consultants' estimates.

Safety-Related Facilities - Navigation Aids, Airport Lighting, Fire and Rescue Equipment: Virtually all of this infrastructure is deemed necessary in the 1981-1985 period. Much of the required facilities are considered necessary immediately to bring the Syrian civil aviation system up to international safety standards for the anticipated scale of operations with an expanded domestic air service.

- Domestic Air Service

In order to develop a viable domestic air service, new aircraft to replace the existing Caravelles have been recommended. The physical facilities needed at the airports, particularly in terms of runways, have been recommended on the basis of turboprop aircraft, such as the F-27, replacing the Caravelles.

It is projected that in the period between 1990 and 2000, domestic passenger traffic will be sufficient to justify a switch-over from F-27 aircraft to B 737 aircraft for domestic service at Damascus, Aleppo, Lattakia, and Deir Ez Zor airports. Should the Government decide to do so, additional investment in airport facilities will be involved. Estimates have been made of the type and magnitude of investments. The estimates are included in the investment schedule in this volume as well as Volume VI.

- International Air Service

A change in the aircraft type used by Syrianair on its international air services is recommended with a switch from the B 747 SP to a smaller B 727 type aircraft. The smaller aircraft is considered operationally far more appropriate for the current and anticipated route structure of Syria's national airline.

Pipelines

The Consultants have carried out detailed inter-modal analyses for the transport of petroleum products in the future. The analysis is presented in Volume VI, Part II, Chapter A-6. In summary, this analysis indicates that rail is more economic than pipelines if the distances are relatively equal and there is adequate rail capacity. When substantial rail investments, such as double tracking, are required, the balance shifts in favor of pipelines. In addition, substantial distance savings, such as a pipeline from Homs directly to Al Raqqa, cause pipelines to be more economic when adequate volumes are reached. However, the cost differences are too small to justify firm decisions on the level of pre-feasibility analysis done in this study. For these reasons the Consultants recommend the following:

- 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 because of their impact on pipeline planning.

Subject to the results of these analyses, the Consultants have forecast the following investments between 1985 and 2000:

- Homs-Adra, SP 109,000,000
- Homs-Al Raqqa direct, SP 105,387,000.

Ports

The major findings with regard to the Ports of Lattakia and Tartous is that, when the planned Tartous Port and the Phase I expansion of Lattakia are completed, Syria will have sufficient port capacity to meet its needs through the year 2000. An important factor in the Consultants' estimates is the apparent trend to increased containerization that is occurring in Syrian traffic as it is elsewhere around the world. Container trends at the two ports must be carefully monitored.

The Syrian phosphate traffic forecast for the year 2000 assumes that a major part of Syria's phosphate will be used for domestic fertilizer production. As a result, even if potential phosphate exports of 4.7 million tons per year from Iraq after 1990 materialize, the Tartous phosphate pier will have adequate capacity. In addition, the sulfur pier proposed for Tartous should be studied further.

Therefore, the Consultants' estimates for port investments in addition to the committed projects are confined to minor investments in equipment required to utilize the facilities effectively.

4.4 EVALUATION OF ALTERNATIVES

4.4.1 Comparison of Alternative Scenarios

Alternative scenarios described in the preceding sections of this chapter would have different impacts on each mode and on the transport sector as a whole. A scenario may have the lowest total cost for one mode but may also have a higher total cost for the other modes, resulting in a higher total system cost.

Alternative scenarios are compared in terms of the present values of total system costs in this section.

No alternative infrastructure developments were examined for the period up to 1985. Because of the long preparation time for any major transport facility project, only fine tuning of the transport sector will be possible as the policy alternative. Moreover, alternative passenger pricing policies (the 2 percent annual increases in relative costs and marginal cost pricing by 2000) not would result in a significant difference by 1985. Therefore, no alternative scenarios were contemplated for the period up to 1985.

For the combined system of road and rail modes, a number of alternative scenarios were developed for the purpose of system evaluation. The alternatives are concerned with:

- pricing schemes for passenger transport,
- modal split between road and rail for commodity transport,
- future railway additions,
- future highway additions, and
- a highway betterment and maintenance program.

Table 4.4-1 summarizes the six system alternatives tested. The A series of alternatives is with the base pricing policy, and the B series is with the marginal cost pricing policy. For each alternative, road systems were tested with the recommended highway betterment and maintenance program and without the program.

In all, 12 combinations of rail and road systems were tested. In order to avoid the estimation of residual values at the end of the study period, cost streams were calculated up to the year 2020 with the traffic level held constant after the year 2000. All costs are from 1981 through 2020 at constant 1980

prices and discounted to the base year 1980. Resulting present values of total system economic costs are summarized in Table 4.4-2.

Total costs, however, vary not only because of differences in system performance but also because of differences in the number of passengers, which is sensitive to pricing policies.

If the number of passengers is reduced because of a price increase, this loss of activity must be accounted for when the economic worth is the measuring yardstick.

In this study, the concept of consumer surplus was applied to measure the amount of economic worth of lost or suppressed passenger trips.

The difference in the total number of passengers betweeen series A and series B alternatives was estimated at 63.6 million passengers trips a year, including external trips for the year 2000. The average per passenger fare was assumed to be SP 3.60 for the alternative A1 and SP 5.63 for alternative B1. (Differences between alternatives within a series are very small.) One-half of this average fare difference multiplied by the difference in the total number of passengers was taken as the value attributable to the lost passenger trips. Discounted present volume of such yearly amounts was calculated assuming exponential growth patterns up to 2000 for both passenger traffic growth and fare increases. These were held constant after 2000. The cost stream is shown in Table 4.4-3. For all series B alternatives, an amount of SP 110 million was added to the discounted total system cost for economic comparison purposes. Such costs, which compensated for the suppressed passenger traffic, are also shown in Table 4.4-2.

Among the system alternatives tested, alternative B22 is the least-cost solution. In other words, a combination of the following policies would result in achieving the least total system economic costs for the combined rail and road transport system in Syria.

- Implementing the recommended highway betterment program.

- Gradually changing passenger transport fares to achieve marginal cost pricing by the year 2000.

- Upgrading the rail network so that the rail mode would capture higher shares than otherwise. This includes construction of the Lattakia-Tartous line and some double tracking.

Table 4.4-1

SUMMARY OF SYSTEM ALTERNATIVES

Alternative Code	Description
Series A	Passenger transport fares of rail, taxi, microbus, and bus fixed at present levels relative to one another but increased by 2 percent per annum relative to non-transport prices.
AO	Low rail share for commodity transport. Rail network addition to the 1985 network is the new Hijaz line only. No new highway links added to the 1985 network.
A1	Low rail share for commodity transport. Rail network additions are the new Hijaz line and the Lattakia-Tartous line. No new highway links added to the 1985 network.
A2	Rail same as in A1. Highway link additions are Tadmur-Albu Kamal, Hama-Al Salamieh-Al Raqqa, and the Aleppo Bypass.
Series B	Passenger transport fares of rail, taxi, microbus, and bus will be set at economic marginal costs of each mode by the year 2000, resulting in a 4 percent per annum price increase as a whole, relative to non-transport costs, and changes will occur in relative prices among the modes.
B1	Low rail share for commodities. Rail network additions are the same as A1 and A2. Highway link additions are the same as in AO and A1.
B2	High rail share for commodities. Rail network additions are the same as in A1 and A2. Highway link additions are the same as in AO and A1 and B1.

Table 4.4-1 (Continued)

SUMMARY OF SYSTEM ALTERNATIVES

Alternative Code	Description
B3	High rail share for commodities. Rail network additions are the same as in A1, A2, and B2, plus the Tadmur-Albu Kamal line. Highway link additions are the same as in AO, A1, and B2.

Note: Each alternative shown above was further divided into two alternatives, with a second digit added. The second digit, 1, indicates cases without the recommended highway betterment and maintenance program and the second digit, 2, is for cases with the recommended program.

Table 4.4-2

COMBINED RAIL AND ROAD SYSTEM COSTS

(in million SP)

System Alternatives	Present Value of Total System Costs[1]	Economic Comparison Costs[2]
Without Betterment and Maintenance Program		
A01	65,128	65,128
A11	65,208	65,208
A21	65,111	65,111
B11	62,898	63,008
B21	62,813	62,923
B31	62,886	62,996
With Betterment and Maintenance Program		
A02	62,145	62,145
A12	62,225	62,225
A22	62,140	62,140
B12	59,900	60,010
B22	59,822	59,932
B32	59,890	60,000

Source: Consultants' estimates.

[1] Sums of cost streams for the period 1981-2000 discounted to 1980 at 12 percent per annum discount rate.

[2] For the B series alternatives economic costs of lost or suppressed passenger trips are added to the actual system costs. (See Table 4.4-3.)

Table 4.4-3

ATTRIBUTED ECONOMIC VALUE OF LOST PASSENGERS

(in million SP per year)

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Value	0	0	0	0	0	1.2	2.7	4.4	6.4	8.7

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Value	11.5	15.2	19.1	23.5	27.4	33.0	39.4	46.7	55.0	64.6

Source: Consultants' estimates.

The largest cost savings come from the proposed highway betterment and maintenance program. Regardless of the other alternative system components, the proposed betterment program would produce a difference of SP 3 billion in terms of present value, or roughly 5 percent of the total combined costs of the rail and road modes. If one examines the breakdown of the present value of total system costs, shown in Table 4.4-4, the effectiveness of this highway betterment and maintenance program is obvious. In all cases, more than 63 percent of the total is attributable to the road vehicle direct operating costs (VOCs). Any means of reducing or preventing an increase in the VOCs is also effective in reducing the total.

In particular, preventive resurfacing is the most effective since road VOCs are very sensitive to highway surface conditions and the cost of resurfacing is relatively inexpensive. Moreover, total costs of resurfacing are not significantly lower without the program because highways deteriorate much faster and have to be resurfaced at the bottom condition anyway. Thus, the proposed highway betterment and maintenance program would reduce the total of road VOCs by 7 percent, with little increase in highway investment costs.

In 1978 the Government owned 12 percent of the total vehicle fleet, which was heavy in buses, 39 percent, and light in trucks, 9 percent. Assuming that per vehicle annual kilometerages of Government vehicles are not different from any others, it is estimated that the Government bore 13 percent of the total road vehicle operating costs in 1978. If this Government share remains stable, cost savings to the Government alone by the highway betterment and maintenance program would be SP 390 million in present value, enough to cover the cost of the projects.

It should be noted that VOCs were calculated not only for inter-zonal traffic but also for local traffic on the primary road network.

The policy of gradual passenger tariff changes to achieve marginal cost pricing for all surface passenger transport modes by the year 2000 would lead to a substantial total system cost reduction more than SP 2 billion in present value after compensating for the suppressed passenger trips. Two factors contribute to this cost reduction.

First, the gradual application of the marginal cost pricing in Syria by the year 2000 will result in an approximately 4 percent per annum increase in the relative price of passenger transport. This increase will induce a 12 percent reduction in the total number of passengers by the year 2000, in comparison

Table 4.4-4

PRESENT VALUE OF SYSTEM COST COMPONENTS

(in million SP)

	System Alternatives							
	A01	A02	A12	A22	B12	B21	B22	B32
Rail								
Operating	2,260	2,260	2,237	2,237	2,260	2,337	2,337	2,328
Rolling Stock	745	745	733	733	743	798	798	792
Other Capital	618	618	753	753	753	820	820	929
Sub-Total	3,623	3,623	3,723	3,723	3,756	3,955	3,955	4,049
Road								
Operating	42,127	39,118	39,108	38,881	38,107	41,013	38,019	38,012
Fleet	18,869	18,869	18,859	18,935	17,529	17,342	17,342	17,325
Maintenance	220	220	220	223	219	218	218	218
Construction	288	314	314	379	289	284	287	287
Sub-Total	61,504	58,521	58,501	58,416	56,144	58,857	55,866	55,841
System Total	65,127	62,144	62,224	62,139	59,900	62,812	59,821	59,890
Compensation for Suppressed Trips	0	0	0	0	110	110	110	110
Total Economic Cost	5,127	62,144	62,224	62,139	60,010	62,922	59,931	60,000

Source: Consultants' estimates.

with the base case, in which a 2 percent per annum increase in costs is assumed. The cost reduction due to the reduced number of passengers outweighs the economic cost of the lost passenger trips.

Second, under marginal cost pricing, the rail mode would be much more attractive to passengers because of its lower tariff vis-a-vis road transport. As a result, the share of the rail mode is higher than otherwise. If the cost increase in the rail mode by adding an additional passenger is less than the cost reduction in the road mode by taking away a passenger, the total system cost decreases. A comparison of alternatives A12 and B12 illustrates this point. The only difference between alternatives A12 and B12 is the passenger transport pricing.

As a proxy to establishing the long-run marginal costs, a comparison of passenger-kilometers and total discounted costs in the year 2000 was made for each mode. The results are summarized in Table 4.4-5. By shifting passenger-kilometers every year from the road to the rail equivalent to one passenger-kilometer in the year 2000, the total present value of the rail mode increases by SP 0.33 but the total present value of the road mode decreases by SP 0.49, resulting in a reduction of the total system cost present value of SP 0.16 per passenger-kilometer. In both alternatives other capital costs are identical, indicating no difference in rail track investments. In other words, capacity constraints are not the problem differentiating these two alternatives. Low rail shares are assumed for freight traffic for both alternatives.

The difference between alternatives B12 and B22 involves capacity problems. Network connections are identical in both alternatives, but alternative B22 carries higher rail shares of commodity traffic. As indicated in Table 4.4-4, earlier double tracking must be done for alternative B22. An analysis similar to that for passenger traffic was made for freight traffic and is summarized in Table 4.4-6. The results show that by shifting freight ton-kilometers equivalent of one ton-kilometer in the year 2000, the present value of the rail mode increases by SP 0.22 but the present value of the road mode decreases by SP 0.30, resulting in a reduction in the total system cost present value of SP 0.08 per ton-kilometer. This occurs even though alternative B2 requires greater double tracking investments than alternative B1.

It is apparent from the foregoing that within the range realistically possible in Syria, the rail mode provides less costly transport for both passengers and commodities. Within a range not overly different from the alternative considered, more traffic on the rail mode would result in a lower total cost of transport.

Table 4.4-5

EFFECT OF PASSENGER TRAFFIC ON TOTAL COST

COMPARISON BETWEEN ALTERNATIVES A1 AND B1

(in billion SP)

	Rail	Road
Total Passenger-kilometers for 2000		
Alternative A12	4.90	37.10
B12	5.00	32.28
A Difference	+ 0.10	-4.82
Total discounted costs		
Alternative A12	3.723	58.501
B12	3.756	56.144
B Difference	+0.033	-2.357
Ratio B/A (SP/pass-km)	0.33	0.49

Source: Consultants' estimates.

Table 4.4-6

EFFECT OF FREIGHT TRAFFIC ON TOTAL COST

COMPARISON BETWEEN ALTERNATIVES B1 AND B2

(in billion SP)

	Rail	Road
Total non-transit freight ton-kilometers for 2000		
Alternative B12	3.62	13.62
B22	4.54	12.70
A Difference	+0.92	-0.92
Total discounted costs		
Alternative B12	3.756	56.144
B22	3.955	55.866
B Difference	+0.205	-0.278
Ratio B/A (SP/ton-km)	0.22	0.30

Source: Consultants' estimates.

A direct comparison of the total system costs of alternatives A0 and A1 indicates that the system with the Lattakia-Tartous railway line would show higher costs than without, under lower rail shares. However, this line will be essential for achieving higher rail shares as stipulated in alternatives B1, B2, and B3.

A comparison of alternatives B2 and B3 shows that the construction of the Tadmur-Albu Kamal railway line after 1986 turns out to be economically unjustified. Higher capital costs would offset slight gains in railway and road operations.

The construction of two highways, the Hama-Al Salamieh-Al Raqqa Highway and the Tadmur-Albu Kamal Highway, after 1995 turn out to be economically justified, as the total system costs of alternatives A1 and A2 indicate. Under the road transport demand in the B series alternatives, net gains due to these highways become less, but the projects are still economically justified.

Construction of the Aleppo Bypass, however, was not included in the road construction cost stream of alternative A2. The reason for the exclusion was that, with the Hama-Al Raqqa Highway and the Tadmur-Albu Kamal Highway included in the year 2000 network, only a small amount of inter-zonal traffic was assigned by the model to this bypass. In actuality, however, such an urban bypass would be used mostly by intra-zonal rather than inter-zonal traffic. Since no local traffic can be generated by the model on new roads, the proper evaluation cannot be done for such urban bypasses with the model.

However, since opening the two new highways in 2000 can be economically justified, there is no doubt that opening the Aleppo Bypass in 1996 can be justified. It should be subjected to a detailed economic feasibility study.

All alternatives are assumed to have identical cost streams up to the year 1985. Differences are assumed only for years after 1985, and the use of a discount rate of 12 percent per year considerably suppresses these differences. Actual differences in current-year costs between the alternatives are more pronounced that they may seem in Tables 4.4-2 and 4.4-4. Between alternatives A02 and B22, the difference in the discounted present value of total system costs is only 3.6 percent, but the difference in the average yearly total cost during the period 1986-2000 is 6 percent, or SP 620 million.

A sensitivity analysis was performed by using a 6 percent discount rate instead of 12 percent. The influence of costs incurred in later years on the total present value is much larger with this lower discount rate. Results are shown in

Table 4.4-7. Major points described above for cases using a discount rate of 12 percent are also valid under the discount rate of 6 percent.

The sensitivity of the ranking of the alternatives to changes in relative costs was also tested. A comparison of differences in total modal costs between alternatives A12 and B12 as shown in Table 4.4-5 indicates that, under any circumstances, any series A alternative would not be the least cost solution. This, of course, is largely due to the smaller number of passenger trips in the series B alternatives.

Alternatives B1 and B2 carry the same number of passengers and commodity tonnages, making the comparison really that of a modal split. Table 4.4-6 indicates that in order for alternative B1 to become the least-cost solution, rail costs must be more than 36 percent higher than the original estimates, or road costs must be more than 26 percent less.

It is unlikely that road costs will increase that much. Cost increases that occurred in the road mode during 1979-1980 were almost this high. Under the pressure of rising energy and labor costs, the costs of the labor- and energy-intensive road mode will not decrease relative to others.

Rail costs depend very much on operating efficiency. A much-improved level of efficiency over the present level was assumed for all alternatives, although the assumed level is still lower than those of European railways. If the rail mode is operated at 62 percent of the efficiency assumed, it would no longer be a favorable mode when earlier double tracking is involved.

In summary, the following conclusions can be drawn from the above analysis.

- The proposed highway betterment program is expected to yield high economic benefits regardless of rail operations.

- The proposed marginal cost pricing for passenger transport would result in substantial total system costs savings, not only because it would suppress excessive passenger trips but also because it would lead to a more desirable split among modes. Its effect of relieving the Government from excessive subsidies to passenger transport is also substantial.

- The rail mode is more cost efficient than the road mode under normal circumstances even when the double tracking of the Damascus-Aleppo line is involved. Efforts should be made in all areas to ensure high rail mode shares of passengers and freight through service level, pricing, marketing, and governmental guidance. The cost advantage of the rail mode, however, depends

on its operating efficiency, which could vary widely. Efforts also must be made to achieve an operating efficiency of at least 65 percent of the level assumed in this study.

- The Tartous-Lattakia railway line should be constructed after 1985. The Tadmir-Albu Kamal railway line should not be constructed before 2000. The Aleppo Bypass (opening in 1995) and the Hama-Al Raqqa Highway and the Tadmur-Albu Kamal Highway (both opening before 2000) are all economically feasible.

4.4.2 Evaluation of Rail Modal Investments

The CFS operating and capital (divided into rolling stock and other capital) cost streams for 1979 to 2020 for cases A1 and B2 are presented in Table 4.4-8.

Once the total system cost analysis was completed, corridor analyses were conducted based on forecasts of trains per line section in 1985 and 2000. These forecasts are shown in Table 4.4-9. From these forecasts, investment requirements for improvements to increase line capacity and subsequent double tracking were derived.

The results are shown in Table 4.4-10. As the table indicates, the difference between cases A1 and B2 for the Damascus-Mhine and Mhine-Homs sections is one of timing. However, improvements to the Jibrine-Al Raqqa, Wadihi-Lattakia, and Homs-Tartous lines are not required before 2000 in the lower traffic case A1. For the reasons discussed in Section 4.4.1 above, these investments are economically justified, as is the construction of the Tartous-Lattakia line after 1985.

4.4.3 Evaluation of Road Modal Investments

General

Economic evaluation of road transport alternatives has been carried out in three stages.

The first stage was performed in the context of the total transport system cost. The Consultants analyzed aggregate levels of investment in road improvements and vehicle fleet expansion and of vehicle operating costs in terms of alternative demand levels for road transport. Proper evaluation can be done only in the context of a total transport system, and the results are presented in Section 4.4.1 above.

The second stage is the evaluation of road projects for the period 1981 through 1985. Committed projects are not the subject of the detailed economic evaluation, in accordance with the TOR section III.B.2.b. As noted above, such committed

projects and existing roads constitute the Consultants' base 1985 road network. There are, however, two projects which are included in the base 1985 road network but are not technically committed by the definition. They are: the Lattakia-Ariha new road, and the Hama-Saraqueb second carriageway.

Feasibility studies were previously carried out for the first two projects. The Consultants reviewed the study reports and found their conclusions acceptable. Projects subjected to the Consultants' own economic analysis in this stage were the Hama-Saraqueb second carriageway project and projects included in the highway betterment and maintenance program. Evaluation of these projects is presented below.

The third stage is the evaluation of projects for the period 1986 through 2000. Probable projects for this period have been identified and an evaluation has been carried out in terms of likely traffic volumes and possible range of benefits.

Lattakia-Ariha New Road

The Lattakia-Ariha corridor is approximately 100 kilometers in length and lies in a difficult terrain. The existing road provides a very low level of serviceability. A feasibility study of a new road for this corridor was carried out by an international consultant, Lyons Associates, in 1977-1978. Lyons Associates concluded that the proposed four-lane highway was technically and economically feasible. The total cost was estimated at US $230.6 million including the right-of-way acquisition and the escalation from 1978 to mid-project point. The economic rate of return was calculated at 19.2 percent and the benefit-cost ratio calculated with a discount rate of 15 percent was 1.5.

The above evaluation was performed for a four-lane highway design, since projected traffic volumes on project links exceeded 4,000 vehicles per day, which was the Ministry of Communications' criterion for this type of road at that time. Lyons Associates performed a comparative analysis for a staged construction of an initial two lanes and an additional two lanes. The study concluded that within six years all sections would require four lanes.

Again, the Consultants found that projected traffic shown in this report did not significantly differ from their own projections and that the methods used and the conclusions were acceptable.

Highway Betterment and Maintenance Methodology

A direct consequence of a poor road surface or inadequate width relative to traffic level is higher vehicle operating costs.

Table 4.4-7

COMBINED RAIL/ROAD SYSTEM COSTS
AT SIX PERCENT DISCOUNT RATE

(in million SP)

System Alternatives	Present Value of Total System Costs	Economic Comparison Costs
A01	138,690	138,690
A02	132,983	132,983
A12	133,020	133,020
A22	132,814	132,814
B11	132,275	132,647
B12	126,460	126,832
B22	126,272	127,387
B32	126,426	126,798

Source: Consultants estimates.

Note: For the B series alternatives economic costs of lost or suppressed trips (estimated at 372 million in present value) are added to the actual system costs.

Table 4.4-8

RAILWAY EXPENDITURES 1979 TO 2020
(million SP at 1980 prices)

1. Case A1

Year	Operating	Rolling Stock	Other Capital	Year	Operating	Rolling Stock	Other Capital
1979	107	--	--	2001	435	31	40
1980	125	--	--	2002	435	31	40
1981	145	80	--	2003	435	31	40
1982	160	100	80	2004	435	31	40
1983	177	100	160	2005	435	31	40
1984	208	100	150	2006	435	50	40
1985	235	90	150	2007	435	50	40
1986	266	87	140	2008	435	50	40
1987	277	87	150	2009	435	50	40
1988	288	87	140	2010	435	50	40
1989	299	87	40	2011	435	92	40
1990	311	87	40	2012	435	92	40
1991	324	104	53	2013	435	92	40
1992	337	104	40	2014	435	92	40
1993	350	104	66	2015	435	92	40
1994	363	104	40	2016	435	90	40
1995	378	104	104	2017	435	90	40
1996	376	88	104	2018	435	90	40
1997	390	88	172	2019	435	90	40
1998	404	88	172	2020	435	90	40
1999	420	88	40				
2000	435	88	40				

Source: Consultants' estimates.

Table 4.4-8 (Continued)

RAILWAY EXPENDITURES 1979 TO 2020
(million SP at 1980 prices)

2. Case B2

Year	Operating	Rolling Stock	Other Capital	Year	Operating	Rolling Stock	Other Capital
1979 to 1985 as Case A1				2001	489	31	50
1986	268	87	145	202	489	31	50
1987	281	110	155	2003	489	31	50
1988	294	87	145	2004	489	31	50
1989	307	87	45	2005	489	31	50
1990	322	129	58	2006	489	50	50
1991	338	104	45	2007	489	50	50
1992	354	104	71	2008	489	50	50
1993	370	156	114	2009	489	50	50
1994	387	104	246	2010	489	50	50
1995	406	164	182	2011	489	92	50
1996	408	88	50	2012	489	99	50
1997	426	153	70	2013	489	92	50
1998	445	88	123	2014	489	92	50
1999	467	160	50	2015	489	103	50
2000	489	88	50	2016	489	90	50
				2017	489	90	50
				2018	489	105	50
				2019	489	90	50
				2020	489	122	50

Source: Consultants' estimates.

Table 4.4-9

TRAINS PER LINE SECTION, 1985 AND 2000

Section CFS	1985 P	1985 F	1985 Total	2000 Case A1 P	2000 Case A1 F	2000 Case A1 Total	2000 Case B2 P	2000 Case B2 F	2000 Case B2 Total
Damascus-Mhine	14	10	24	28	20	48	30	26	56
Mhine-Homs	14	16	30	28	30	58	30	36	66
Homs-Hama	14	16	30	22	16	38	24	20	44
Hama-Mhardeh	0	2	2	0	2	2	0	2	2
Hama-Wadihi	14	14	28	22	12	34	24	16	40
Wadihi-Ansari	20	18	38	32	28	60	34	36	70
Ansari-Aleppo	32	4	36	50	4	54	54	4	58
Aleppo-Midan Ikbis	2	4	6	4	4	8	4	4	8
Jibrine-Al Raqqa	12	14	26	18	20	38	20	22	42
Al Raqqa-Deir Ez Zor	8	8	16	12	18	30	12	22	34
Deir Ez Zor-Al Hassakeh	6	2	8	8	6	14	8	8	16
Al Hassakeh-Al Kamishli	4	2	6	4	4	8	4	4	8
Al Kamishli-Ya'roubia	0	2	2	2	2	4	2	2	4

Table 4.4-9 (Continued)

TRAINS PER LINE SECTION, 1985 AND 2000

Section CFS	1985			2000 Case A1			2000 Case B2		
	P	F	Total	P	F	Total	P	F	Total
Wadihi-Lattakia	6	8	14	10	16	26	10	20	30
Homs-Tartous	4	10	14	10	18	28	12	22	34
Mhine-Phosphate Mines	0	6	6	0	10	10	0	10	10
Deir Ez Zor-Albu Kamal	4	6	10	8	12	20	8	12	20
Tartous-Lattakia	-	-	-	6	16	22	6	18	24
Annual Train Kilometers (million)	4.65	5.15	9.80	8.10	8.87	16.97	8.62	10.51	19.13
Damascus-Dera'a	-	-	-	20	8	28	20	8	28
Dera'a-Jordanian Border	-	-	-	8	8	16	8	8	16
Annual Train Kilometers (million)	-	-	-	0.88	0.38	1.26	0.88	0.38	1.26

Source: Consultants' estimates.

Notes: Excludes railcar services.
P = Passenger.
F = Freight.

Table 4.4-10

LINE CAPACITY IMPROVEMENTS, 1985 TO 2000

Line Section	Case A1		Case B2		Cost Million SP	
	Improve	Double Track	Improve	Double Track	Improve	Double Track
Damascus-Mhine	1993	1997/98	1992	1994/95	26	264
Mhine-Homs	1991	1995/96	1990	1993/94	13	128
Jibrine-Al Raqqa	-	-	1998	-	38	-
Wadihi-Lattakia	-	-	1998	-	35	-
Homs-Tartous	-	-	1997	-	20	-

Source: Consultants' estimates.

Notes: Dates shown are construction dates.

Costs at 1980 prices, assuming SP 1.9 million per route kilometer for double tracking and SP 0.19 million for improvement.

The direct benefit of highway betterment and maintenance is the difference in vehicle operating costs on roads with and without such betterment or maintenance. If the discounted present value of the benefit exceeds the present value of the cost, the betterment or maintenance operation is economically worthwhile.

A computer model for the economic evaluation of the highway betterment and maintenance program has been developed by the Consultants. It was designed to perform the following for each road link of the network:

- Determine, year by year, Average Daily Traffic (ADT) after accepting results from the traffic assignment model.

- Calculate annual betterment costs whenever economically justified under the projected ADT stream following the highway betterment and maintenance program.

- Calculate annual resurfacing costs when applicable under the existing practice.

- Calculate annual maintenance costs.

- Calculate annual total VOCs as a sum of VOCs of eight vehicle types over the link for the with and without case.

The economic evaluation of link betterment is carried out on the basis of the first-year return for the widening and on the basis of the benefit-cost ratio for the resurfacing with the benefit being the difference in VOC with and without the work. (The benefit-cost ratio was used in resurfacing because of its short life.)

The model also accumulates total system cost over the entire network to be used in the system evaluation as explained in Section 4.3 and to develop total costs by Mohafaza for the purpose of developing the road betterment and maintenance budget, which is presented in Section 4.5 below.

Priority Ranking of Primary Road Betterment Projects

Table 4.4-11 indicates the priority ranking by year of the primary road network based on the above. Only economically justifiable projects were selected. This priority ranking evaluation by year was based on the first-year return (FYR):

$$FYR = \frac{\text{First Year Benefits}}{\text{Betterment Costs}}$$

The projects are listed in Table 4.4-11 in priority order by year. Where the same link shows projects in successive years, i.e., Damascus-Zabadani, it will almost certainly be advisable

Table 4.4-11

PRIMARY ROAD BETTERMENT PROJECT RANKING BY FIRST YEAR RETURN 1981-1985

LINK		LOCATION	MOHAFAZA	LENGTH (KM)	OPERATION	RANKING 1981	1982	1983	1984	1985
1602	1604	DAMASCUS-ZABADANI	DAMASCUS	.80	RESUR. +WDNNG	1	48	0	0	0
3107	3109	IFRIN-IDLEB	ALOPPO	11.70	RESURFACING	2	0	0	0	0
2502	2505	MISSIAF-BANIAS	TARTOUS	.10	RESUR. +WDNNG	3	25	0	0	0
115	2502	MISSIAF-BANIAS	TARTOUS	4.20	RESURFACING	4	0	0	0	0
2401	2403	MISSIAF-HAMA	HAMA	33.10	RESUR. +WDNNG	5	0	0	3	0
3909	3910	KAMISHLI-RAS AL AIN	AL HASSAKE	.40	RESUR. +WDNNG	6	0	2	0	0
3109	3112	IFRIN-IDLEB	ALOPPO	26.50	RESUR. +WDNNG	7	23	0	0	0
518	519	SARAQUEB-AL MA'ARRAT	IDLEB	.50	RESURFACING	8	0	0	0	0
150	102	KASSAB-LATTAKIA	LATTAKIA	16.90	RESUR. +WDNNG	9	53	0	0	0
207	3608	RADDA-TAL ABIAD	AL RADDA	6.00	RESURFACING	10	0	0	0	0
3201	3202	IFRIN-TURKEY BORDER	ALOPPO	21.50	RESURFACING	11	0	0	0	0
3103	3104	ALEPPO-IZAZ	ALOPPO	1.00	RESUR. +WDNNG	12	10	0	0	0
2403	2101	HOMS-MISSIAF	HAMA	20.80	RESURFACING	13	0	0	0	0
3101	3103	ALEPPO-IZAZ	ALOPPO	25.10	RESURFACING	14	0	0	0	0
3112	504	IFRIN-IDLEB	ALOPPO	7.20	RESURFACING	15	0	0	0	0
129	130	LEB BORDER-TARTOUS	TARTOUS	11.20	RESURFACING	16	0	0	0	0
3410	3411	MANBJ JARABLUS	ALOPPO	34.70	RESURFACING	17	0	0	0	0
103	105	KASSAB-LATTAKIA	LATTAKIA	9.60	RESURFACING	18	0	0	0	0
2914	2915	IDLEB-HAREM	IDLEB	2.60	RESURFACING	19	0	0	0	0

Table 4.4-11 (Cont'd)

PRIMARY ROAD BETTERMENT PROJECT RANKNG BY FIRST YEAR RETURN 1981-1985

LINK		LOCATION	MOHAFAZA	LENGTH (KM)	OPERATION	RANKING 1981	1982	1983	1984	1985
1609	1610	DAMASCUS-ZABADANI	DAMASCUS	.70	WDNNG +RESUR	20	1	0	0	0
2601	2606	SUQAILBIEH-HAMA	HAMA	42.50	RESURFACING	21	0	0	0	0
505	506	BAB AL HAWA-ALEPPO	ALOPPO	1.90	RESURFACING	22	0	0	0	0
2204	2205	SALAMIA-HOMS	HOMS	2.40	RESUR +WDNNG	23	0	7	0	0
224	517	TAFTANAZ-MA'ARRAT	IDLEB	3.00	RESURFACING	24	0	0	0	0
3901	3905	HAMISHLI-RAS AL AIN	AL HASSAKE	26.20	RESURFACING	25	0	0	0	0
3104	3105	ALEPPO-IZAZ	ALOPPO	20.00	RESURFACING	26	0	0	0	0
2401	2404	MISSIAF-HAMA	HAMA	6.60	RESURFACING	27	0	0	0	0
3905	3906	HAMISHLI-RAS AL AIN	AL HASSAKE	.40	RESUR +WDNNG	28	21	0	0	0
3906	3909	HAMISHLI-RAS AL AIN	AL HASSAKE	7.70	RESURFACING	29	0	0	0	0
224	2902	TAFTANAZ-IDLEB	IDLEB	14.30	RESURFACING	30	0	0	0	0
3202	3203	IFRIN-TURKEY BORDER	ALOPPO	8.90	RESUR +WDNNG	31	29	0	0	0
2101	2204	SALAMIA-MISSIAF	HOMS	48.30	RESURFACING	32	0	0	0	0
751	708	DER EZ ZOR-AL HASSAKEH	DIER EZ ZOR	64.10	RESURFACING	33	0	0	0	0
316	325	AL RAQQA-DER EZ ZOR	DIER EZ ZOR	62.30	RESURFACING	34	0	0	0	0
2911	2914	IDLEB-HAREM	IDLEB	9.60	RESUR +WDNNG	35	34	0	0	0
308	316	AL RAQQA-DER EZ ZOR 1	AL RAQQA	59.90	RESURFACING	36	0	0	0	0
812	816	DAMASCUS-TADMUR	DAMASCUS	83.40	RESURFACING	37	0	0	0	0
3910	3925	HAMISHLI-RAS AL AIN	AL HASSAKE	75.60	RESURFACING	38	0	0	0	0

Table 4.4-11 (Cont'd)

PRIMARY ROAD BETTERMENT PROJECT RANKING BY FIRST YEAR RETURN 1981-1985

LINK		L O C A T I O N	MOHAFAZA	LENGTH (KM)	OPERATION	R A N K I N G 1981	1982	1983	1984	1985
1420	1421	SUWEIDA-BOUSRA	AL SWEIDA	1.30	WDNNG. +RESUR	39	13	0	0	0
3105	3107	IFRIN-IZAZ	ALOPPO	9.50	RESUR. +WDNNG	40	22	0	0	0
3603	3604	RAQQA-TAL ABIAD	AL RAQQA	56.30	RESURFACING	41	0	0	0	0
709	717	DER EZ ZOR-AL HASSAKEH	AL HASSAKE	107.20	RESURFACING	42	0	0	0	0
340	339	ALMAYADIN-ALBU KAMAL	DIER EZ ZOR	86.80	RESURFACING	43	0	0	0	0
1310	906	IZRA - QUNEITRA	QUNEITRA	15.00	RESURFACING	44	0	0	0	0
508	2903	IDLEB-ALEPPO	IDLEB	33.70	RESURFACING	45	0	0	0	0
2606	2402	SUQAILBIEH-HAMA	HAMA	30.80	RESURFACING	46	0	0	0	0
2906	2911	IDLEB-HAREM	IDLEB	20.40	RESURFACING	47	0	0	0	0
2205	2206	SALAMIA-HOMS	HOMS	7.70	RESUR. +WDNNG	48	42	0	0	0
1102	1103	SALKHAD-BOUSRA	AL SWEIDA	13.00	RESURFACING	49	0	0	0	0
3502	3504	IZAZ-TURKEY BORDER	ALOPPO	4.40	RESURFACING	50	0	0	0	0
2206	2209	SALAMIA-HOMS	HAMA	16.50	RESURFACING	51	0	0	0	0
2802	2803	MA'ARRAT-ARIHA	IDLEB	2.30	WDNNG. +RESUR	52	0	1	0	0
2505	2405	MISSIAF-BANIAS	HAMA	15.10	RESURFACING	53	0	0	0	0
2905	2906	IDLEB-HAREM	IDLEB	4.50	RESUR. +WDNNG	54	51	0	0	0
1002	502	BAB AL HAWA-ALEPPO	IDLEB	8.60	RESURFACING	55	0	0	0	0
701	603	ABU ALSHAMAT-TADMUR	HOMS	41.10	RESURFACING	56	0	0	0	0
301	302	ALEPPO-EAST. OF ALEPPO	ALOPPO	10.00	RESURFACING	57	0	0	0	0

Table 4.4-11 (Cont'd)

PRIMARY ROAD BETTERMENT PROJECT RANKNG BY FIRST YEAR RETURN 1981-1985

LINK		LOCATION	MOHAFAZA	LENGTH (KM)	OPERATION	RANKING 1981	1982	1983	1984	1985
2407	121	MISSIAF-TARTOUS	TARTOUS	40.50	RESURFACING	58	0	0	0	0
1102	1110	AL SUWEIDA-QUNEITRA	DARAA	71.00	RESURFACING	59	0	0	0	0
2612	2613	JISR SHUGHOUR-HARM	IDLEB	.60	RESURFACING	60	0	0	0	0
2406	2407	MISSIAF-TARTOUS	HAMA	14.50	RESURFACING	61	0	0	0	0
106	107	LATTAKIA-KASSAB	LATTAKIA	13.20	RESURFACING	62	0	0	0	0
1101	1102	AL SUWEIDA-IZRA'	AL SWEIDA	5.50	RESUR +WDNNG	63	41	0	0	0
105	106	KASSAB-LATTAKIA	LATTAKIA	13.40	RESUR +WDNNG	64	55	0	0	0
2613	2614	JISR SHUGHOUR-HARM	IDLEB	19.20	WIDENING	65	0	0	0	0
2611	2612	JISR SHUGHOUR-HARM	IDLEB	24.20	RESURFACING	66	0	0	0	0
2005	2006	IDLEB-ARIHA	IDLEB	9.00	WIDENING	67	0	0	0	0
2619	2620	HARM-ALEPPO	IDLEB	25.00	WIDENING	68	0	0	0	0
131	140	DER EZ ZOR-AL MAYADIN	DIER EZ ZOR	4.00	WDNNG. +RESUR	69	17	0	0	0
1609	1610	DAMASCUS-ZABADANI	DAMASCUS	.70	WDNNG. +RESUR	20	1	0	0	0
802	1601	DAMASCUS-ZABADANI	DAMASCUS	5.90	WIDENING	0	2	0	0	0
517	518	SARAQUEB-AL MA'ARRAT	IDLEB	3.40	RESURFACING	0	3	0	0	0
521	522	MA'ARRAT-HAMA	HAMA	2.40	RESURFACING	0	4	0	0	0
511	512	BAB AL HAWA-ALEPPO	ALOPPO	2.40	RESUR. +WDNNG	0	5	15	0	0
1501	1504	DAMASCUS-AEROPORT	DAMASCUS	21.70	RESURFACING	0	6	0	0	0
802	1608	DAMASCUS-ZABADANI	DAMASCUS	2.00	RESUR. +WDNNG	0	7	6	0	0

Table 4.4-11 (Cont'd)

PRIMARY ROAD BETTERMENT PROJECT RANKING BY FIRST YEAR RETURN 1981-1985

LINK		LOCATION	MOHAFAZA	LENGTH (KM)	OPERATION	RANKING 1981	1982	1983	1984	1985
2011	2012	SAFITA-TARTOUS	TARTOUS	5.70	RESURFACING	0	8	0	0	0
2009	2010	SAFITA-TARTOUS	TARTOUS	6.50	RESURFACING	0	9	0	0	0
3101	3104	ALEPPO-IZAZ	ALOPPO	1.00	RESUR. +WDNNG	12	10	0	0	0
501	504	BAB AL HAWA-ALEPPO	IDLEB	2.00	RESURFACING	0	11	0	0	0
504	505	BAB AL HAWA-ALEPPO	ALOPPO	4.60	RESURFACING	0	12	0	0	0
1420	1421	SUWEIDA-BOUSRA	AL SWEIDA	1.30	WDNNG +RESUR	39	13	0	0	0
1421	1101	SUWEIDA-BOUSRA	AL SWEIDA	15.70	RESURFACING	0	14	0	0	0
2620	501	HAMA-ALEPPO	IDLEB	4.00	RESURFACING	0	15	0	0	0
909	911	DAMASCUS-QUNEITRA	QUNEITRA	27.00	RESURFACING	0	16	0	0	0
201	240	DER EZ ZOR-AL MAYADIN	DIER EZ ZOR	4.00	WDNNG. +RESUR	69	17	0	0	0
2007	2008	SAFITA-TARTOUS	TARTOUS	2.70	RESUR. +WDNNG	0	18	12	0	0
506	511	BAB AL HAWA-ALEPPO	ALOPPO	23.50	RESURFACING	0	19	0	0	0
902	905	DAMASCUS-QUNEITRA	DAMASCUS	23.40	RESURFACING	0	20	0	0	0
3905	3906	KAMISHLI-RAS AL AIN	AL HASSAKE	.40	RESUR. +WDNNG	28	21	0	0	0
3105	3107	IARIN-IZAZ	ALOPPO	9.50	RESUR. +WDNNG	40	22	0	0	0
3109	3112	IARIN-IDLEB	ALOPPO	26.50	RESUR. +WDNNG	7	23	0	0	0
719	721	HASSANEH-KAMISHLI	AL HASSAKE	65.30	RESURFACING	0	24	0	0	0
2502	2505	MISSIAF-BANIAS	TARTOUS	27.10	RESUR. +WDNNG	3	25	0	0	0
1608	1609	DAMASCUS-ZABADANI	DAMASCUS	11.70	RESURFACING	0	26	0	0	0

Table 4.4-11 (Cont'd)

PRIMARY ROAD BETTERMENT PROJECT RANKING BY FIRST YEAR RETURN 1981-1985

LINK		LOCATION	MOHAFAZA	LENGTH (KM)	OPERATION	RANKING 1981	1982	1983	1984	1985
3106	3501	IZAZ-IFRIN	ALOPPO	3.20	RESURFACING	0	27	0	0	0
1408	1420	DAMASCUS-AL SUWEIDA	AL SWEIDA	62.70	RESURFACING	0	28	0	0	0
3202	3203	IFRIN-TURKEY BORDER	ALOPPO	8.90	RESUR. +WDNNG	31	29	0	0	0
1407	1409	DAMASCUS-AL SUWEIDA	DARAA	7.50	RESURFACING	0	30	0	0	0
1404	1407	DAMASCUS-AL SUWEIDA	DAMASCUS	23.30	RESURFACING	0	31	0	0	0
2102	2103	SALAMIA-HAMA	HAMA	29.10	RESURFACING	0	32	0	0	0
2608	2609	SUWAILBIEH-JISR SHUGH.	HAMA	20.50	RESURFACING	0	33	0	0	0
2911	2914	IDLEB-HAREM	IDLEB	9.60	RESUR. +WDNNG	35	34	0	0	0
325	111	DEIR EZ ZOR-AL MAYADIN	DIER EZ ZOR	40.60	RESURFACING	0	35	0	0	0
602	603	THOMUR	HOMS	1.10	RESURFACING	0	36	0	0	0
2609	2610	SUWAILBIEH-JISR SHUGHOUR	IDLEB	8.00	RESURFACING	0	37	0	0	0
2012	128	SAFITA-TARTOUS	TARTOUS	2.10	RESUR. +WDNNG	0	38	4	0	0
303	304	AL TABKAH-ALEPPO	ALOPPO	93.10	RESURFACING	0	39	0	0	0
304	308	TABKAH-AL RAQQA	AL RAQQA	78.10	RESURFACING	0	40	0	0	0
1301	1302	AL SUWEIDA-IZRA'	AL SWEIDA	5.50	RESUR. +WDNNG	63	41	0	0	0
2205	2206	SALAMIA-HOMS	HOMS	7.70	RESUR. +WDNNG	48	42	0	0	0
1104	1105	SALKHAD-BOUSRA	DARAA	4.50	RESURFACING	0	43	0	0	0
2606	2607	SUWAILBIEH-JISR SHUGH.	HAMA	5.20	RESURFACING	0	44	0	0	0
221	222	ARIHA-SARAQUEB	IDLEB	2.70	RESURFACING	0	45	0	0	0

Table 4.4-11 (Cont'd)

PRIMARY ROAD BETTERMENT PROJECT RANKNG BY FIRST YEAR RETURN 1981-1985

LINK		L O C A T I O N	MOHAFAZA	LENGTH (KM)	OPERATION	R A N K I N G 1981	1982	1983	1984	1985
2607	2608	SUQAILBIEH-JISR SHUGH.	HAMA	21.70	RESUR. +WDNNG	0	46	19	0	0
1105	1106	SALKHAD-BOUSRA	DARAA	1.10	RESUR. +WDNNG	0	47	8	0	0
1603	1604	DAMASCUS-ZABADANI	DAMASCUS	.80	RESUR. +WDNNG	1	48	0	0	0
1106	1109	BOUSRA-DERA'A	DARAA	25.90	RESURFACING	0	49	0	0	0.
584	1902	HOMS-ALQUSEIR	HOMS	25.90	RESURFACING	0	50	0	0	0
2905	2906	IDLEB-HAREM	IDLEB	4.50	RESUR. +WDNNG	54	51	0	0	0
1102	1104	SALKHAD-BOUSRA	AL SWEIDA	3.40	RESURFACING	0	52	0	0	0
150	102	KASSAB-LATTAKIA	LATTAKIA	16.90	RESUR. +WDNNG	9	53	0	0	0
1401	1402	DAMASCUS-AL SUWEIDA	DAMASCUS	5.80	RESURFACING	0	54	0	0	0
105	106	KASSAB-LATTAKIA	LATTAKIA	13.40	RESUR. +WDNNG	64	55	0	0	0
2010	2011	SAFITA-TARTOUS	TARTOUS	4.20	RESUR. +WDNNG	0	56	20	0	0
1402	1404	DAMASCUS-AL SUWEIDA	DAMASCUS	.80	RESUR. +WDNNG	0	57	21	0	0
505	506	DAMASCUS-DERA'A	DAMASCUS	2.60	WIDENING	0	58	0	0	0
2802	2803	MA'ARRAT-ARIHA	IDLEB	2.30	WDNNG. +RESUR	52	0	1	0	0
3909	3910	KAMISHLI-RAS AL AIN	AL HASSAKE	.40	RESUR. +WDNNG	6	0	2	0	0
816	819	ABU AL SHAMAT-TANF	HOMS	170.80	RESURFACING	0	0	3	0	0
2012	128	SAFITA-TARTOUS	TARTOUS	2.10	RESUR. +WDNNG	0	38	4	0	0
2004	2005	HOMS-SAFITA	TARTOUS	.10	RESUR. +WDNNG	0	0	5	10	0
802	1603	DAMASCUS-ZABADANI	DAMASCUS	2.00	RESUR. +WDNNG	0	7	6	0	0

Table 4.4-11 (Cont'd)

PRIMARY ROAD BETTERMENT PROJECT RANKNG BY FIRST YEAR RETURN 1981-1985

LINK		L O C A T I O N	MOHAFAZA	LENGTH (KM)	OPERATION	R A N K I N G 1981	1982	1983	1984	1985
2204	2205	SALANIA-HOMS	HOMS	2.40	RESUR. +WDNNG	23	0	7	0	0
1105	1106	SALKHAD-BOUSRA	DARAA	1.10	RESUR. +WDNNG	0	47	8	0	0
2616	2619	JISR SHUGHOUR-HARM	IDLEB	10.40	RESURFACING	0	0	9	0	0
502	503	BAB AL HAWA-ALEPPO	IDLEB	4.60	RESURFACING	0	0	10	0	0
406	407	HOMS-TAL KALAKH	HOMS	35.10	RESURFACING	0	0	11	0	0
2007	2008	SAFITA-TARTOUS	TARTOUS	2.70	RESUR. +WDNNG	0	18	12	0	0
2801	2802	MA'ARRAT-ARIHA	IDLEB	20.30	RESURFACING	0	0	13	0	0
409	411	HOMS-TAL KALAKH	HOMS	7.60	RESUR. +WDNNG	0	0	14	4	0
511	512	BAB AL HAWA-ALEPPO	ALOPPO	2.40	RESUR. +WDNNG	0	5	15	0	0
412	2001	HOMS-SAFITA	HOMS	11.20	RESUR. +WDNNG	0	0	16	0	14
559	812	DAMASCUS-ABU AL SHAMAT	DAMASCUS	6.80	RESURFACING	0	0	17	0	0
2001	2002	HOMS-SAFITA	HOMS	2.20	RESURFACING	0	0	18	0	0
2607	2608	SUMAILBIEH-JISR SHUGH.	HAMA	21.70	RESUR. +WDNNG	0	46	19	0	0
2010	2011	SAFITA-TARTOUS	TARTOUS	4.30	RESUR. +WDNNG	0	56	20	0	0
1403	1404	DAMASCUS-AL SUWEIDA	DAMASCUS	.80	RESUR. +WDNNG	0	57	21	0	0
2005	2007	HOMS-SAFITA	TARTOUS	19.90	RESURFACING	0	0	22	0	0
2002	2004	HOMS-SAFITA	HOMS	26.30	RESUR. +WDNNG	0	0	23	12	0
1605	1606	DAMASCUS-ZABADANI	DAMASCUS	1.00	RESURFACING	0	0	0	1	0
1601	1602	DAMASCUS-ZABADANI	DAMASCUS	1.20	RESURFACING	0	0	0	2	0

Table 4.4-11 (Cont'd)

PRIMARY ROAD BETTERMENT PROJECT RANKNG BY FIRST YEAR RETURN 1981-1985

LINK		L O C A T I O N	MOHAFAZA	LENGTH (KM)	OPERATION	R A N K I N G 1981	1982	1983	1984	1985
2401	2403	MISSIAF-HAMA	HAMA	33.10	RESUR. +WDNNG	5	0	0	3	0
409	411	HOMS-TAL KALAKH	HOMS	7.60	RESUR. +WDNNG	0	0	14	4	0
567	1003	DAMASCUS-DERA'A	DAMASCUS	9.90	RESURFACING	0	0	0	5	0
816	701	ABU ALSHAMAT-TADMUR	HOMS	54.00	RESURFACING	0	0	0	6	0.
223	224	ARIHA-SARAQUEB	IDLEB	18.20	RESURFACING	0	0	0	7	0
109	213	LATTAKIA-JISR SHUGHOUR	LATTAKIA	60.70	RESURFACING	0	0	0	8	0
1607	1608	DAMASCUS-ZABADANI	DAMASCUS	6.60	RESURFACING	0	0	0	9	0
2004	2005	HOMS-SAFITA	TARTOUS	.10	RESUR. +WDNNG	0	0	5	10	0
213	214	LATTAKIA-JISR SHUGHOUR	IDLEB	10.40	RESURFACING	0	0	0	11	0
2002	2004	HOMS-SAFITA	HOMS	26.30	RESUR. +WDNNG	0	0	23	12	0
738	4001	'A'ROUBIA-MALKIAH	AL HASSAKE	34.00	RESURFACING	0	0	0	0	1
519	521	SARAQUEB-AL MA'ARRAT	IDLEB	11.60	RESURFACING	0	0	0	0	2
3604	3605	RAQQA-TAL ABIAD	AL RAQQA	11.60	RESURFACING	0	0	0	0	3
131	112	JABLEH-BANIAS	LATTAKIA	22.20	RESURFACING	0	0	0	0	4
733	737	HASSAKEH-'A'ROUBIA	AL HASSAKE	28.40	RESURFACING	0	0	0	0	5
801	803	DAMASCUS-LEB. BORDER	DAMASCUS	28.00	RESURFACING	0	0	0	0	6
123	124	TARTOUS-BANIAS	TARTOUS	2.20	RESURFACING	0	0	0	0	7
803	805	DAMASCUS-LEB. BORDER	DAMASCUS	4.60	RESURFACING	0	0	0	0	8
112	114	JABLEH-BANIAS	TARTOUS	4.40	RESURFACING	0	0	0	0	9

Table 4.4-11 (Cont'd)

PRIMARY ROAD BETTERMENT PROJECT RANKNG BY FIRST YEAR RETURN 1981-1985

LINK		LOCATION	MOHAFAZA	LENGTH (KM)	OPERATION	RANKING 1981	1982	1983	1984	1985
128	129	TARTOUS-LEB. BORDER	TARTOUS	14.30	RESURFACING	0	0	0	0	10
1002	578	DAMASCUS-DERA'A	DARAA	52.60	RESURFACING	0	0	0	0	11
216	219	JISR AL SHUGHOUR-ARIHA	IDLEB	40.70	RESURFACING	0	0	0	0	12
120	122	BANIAS-TARTOUS	TARTOUS	4.70	RESURFACING	0	0	0	0	13
412	2001	HOMS-SAFITA	HOMS	11.20	RESUR.+WDNNG	0	0	16	0	14
402	407	HOMS-TAL KALAKH	HOMS	45.20	RESURFACING	0	0	0	0	15
224	516	ARIHA-SARAQUEB	IDLEB	2.20	RESURFACING	0	0	0	0	16
598	1020	NABEK-HOMS	HOMS	2.20	RESURFACING	0	0	0	0	17
592	1015	[illegible]SCUS-NABEK	DAMASCUS	4.75	RESURFACING	0	0	0	0	18
591	592	DAMASCUS-NABEK	DAMASCUS	.25	RESURFACING	0	0	0	0	19
594	595	NABEK-HOMS	HOMS	21.75	RESURFACING	0	0	0	0	20
596	597	NABEK-HOMS	HOMS	5.90	RESURFACING	0	0	0	0	21

Source: Consultants' estimates.

to combine them into a single project. This will have to be determined on a link by link basis. There may also be instances where this will apply to projects two years apart, i.e., Ma'arrat-Ariha.

Hama-Saraqueb Second Carriageway

The north-south corridor between Damascus and Aleppo is the most heavily trafficked route in Syria. A good part of it is already served by a four-lane dual carriageway, and construction is underway for the remaining part to extend the dual carriageway except for the section between Hama and Saraqueb. A plan does exist for this section to complete the dual carriageway over the entire length of the corridor, but the project had not officially been funded by the middle of October 1980.

The Consultants carried out a brief study to determine the economic feasibility of constructing a paralleling second carriageway for this section.

Physical characteristics of the existing and the proposed carriageways are shown in Table 4.4-12. Project costs were estimated on the basis of unit costs shown in Table 4.4-13. The costs were allocated over the construction period of five years. Benefits were calculated as the difference in vehicle operating costs with the project and without the project. The Consultants' road vehicle operating cost model was applied. Projected traffic volumes were supplied by the traffic assignment model. Road surface deterioration and periodic maintenance were assumed for cases with and without the project. Details of the models have been described previously. Resultant cost and benefit streams are presented in Table 4.4-14 along with economic evaluation indicators.

At the discount rate of 12 percent per annum, the net present value is estimated at SP 897 million, the benefit-cost ratio at 11.3, and the economic rate of return at 60 percent. The very high level of benefit is due to relieving congestion. The project is economically feasible.

4.4.4 Evaluation of Port Modal Investments

Proposed port investments are generally minor engineering and equipment replacements and improvements. Major new infrastructure investments have not been proposed. There is, however, a significant list of small measures which will add to port productivity and to better use of existing and developing capital facilities. Some investments in equipment are recommended on the basis of physical criteria, such as container handling equipment, and on the basis of forecast workload. The

Table 4.4-12

HAMA-SARAQUEB DUAL CARRIAGEWAY CHARACTERISTICS

	Existing Carriageway	Second Carriageway
Length (km)	85.5	85.5
Pavement Width (m)	7.3	7.3
Surface Type	A.C.	A.C.
Average Grade (%)	3-5	3-5
Length at Grade (km)	9.9	5.0
Number of Curves	1	0
Number of Side Frictions	10	10
1979 Two-way Traffic ADT	9560	
Estimated 1985 ADT	12950	
2000 ADT	29540	

Table 4.4-13

HAMA-SARAQUEB SECOND CARRIAGEWAY UNIT CONSTRUCTION COSTS
(in thousand SP/Km)

Cost Item	Financial Costs	Economic Costs
Construction	1,232	1,084
Right of Way	140	140
Engineering and Control	185	185
Contingency	185	157
Total	1,742	1,566

Source: Consultants' estimates.

Table 4.4-14

HAMA-SARAQUEB ADDITIONAL CARRIAGEWAY ECONOMIC EVALUATION

Discount Rate	12%
Present Value of Benefits	984
Present Value of Costs	87
Net Present Value	897
Benefit Cost Ratio	11.26
Internal Rate of Return	60%

Year	Benefits	Costs	Year	Benefits	Costs
1980	0	0	2001	341	0
1981	0	0	2002	302	0
1982	0	20	2003	335	0
1983	0	33	2004	341	0
1984	0	33	2005	302	0
1985	0	40	2006	335	0
1986	153	7	2007	341	0
1987	140	0	2008	302	0
1988	157	0	2009	335	0
1989	166	0	2010	341	0
1990	153	0	2011	302	0
1991	185	0	2012	335	0
1992	207	0	2013	341	0
1993	196	0	2014	302	0
1994	228	0	2015	335	0
1995	235	0	2016	341	0
1996	225	0	2017	302	0
1997	264	0	2018	335	0
1998	283	0	2019	341	0
1999	272	0	2020	302	0
2000	318	0			

Source: Consultants' estimates.

investments involved are relatively minor in amount. For the 5th Plan they are 4 percent of the amount the Government has already committed for investment in the two ports. For the period 1986 to 2000 they are less than 2 percent of the probable investment in the transport sector.

Moreover, segregating the productivity of a given piece or set of equipment is a detailed and time-consuming task, and the assumption involved will leave any result open to question. Because of this, the Consultants have not undertaken economic analysis of the investments. The investments are justified on the grounds of efficiency, workload, and realization of the benefits from the heavy port investment now underway.

4.4.5 Evaluation of Other Modal Investments

Civil Aviation

A large portion of the investment programs outlined in chapters on civil aviation (Volume VI) is for the international facilities and Aleppo that are already committed.

The committed investment comprises largely expenditures for safety and navigational equipment for which formal economic justification is not applicable. The remainder of the uncommitted investment represents expenditures that will not be required until after 1985; their justification should be part of the analysis that has been recommended.

Thus, the Consultants' economic evaluation is confined to the domestic part of the investment program for which major expenditures are predicted on new traffic generation (see Volume VI, Chapter 6).

The economic evaluation carried out by the Consultants shows that investment in domestic airway facilities is not economically justified. The results suggest that either the assumed rates of user fees are too low or, if the domestic air service is to be expanded, a significant subsidy will be required. Based on income levels, it is unlikely that user fees can be set above levels assumed in the analysis.

The decision on investment in domestic air service may ultimately be made on social and political considerations, which obviously are beyond the scope of the present study.

Pipelines

Inter-modal analysis for the transport of petroleum products was carried out by the Consultants (Volume VI, Part II, Chapter A-6).

Three modes were considered for the transport of oil products in the future: road, pipeline, and rail. Of the three, road has a 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 pipelines is a function of volumes available and capacity on the railroad. All rail calculations have assumed capital costs for rolling stock only and availability of right-of-way capacity. 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, pipeline 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 fully served by pipeline until after 2000. Finally, a pipeline to supply areas south of Damascus is not immediately viable even compared to road transport.

4.5 INVESTMENT PROGRAM AND PRIORITIES

4.5.1 Investment Plan 1981-1985

All costs, including the financial costs presented in this section, are in terms of constant 1980 Syrian pounds.

The Consultants' recommended investment plan for the transport sector is summarized by mode in Table 4.5-1. Details by project are shown in Table 4.5-2. Committed projects comprise 73 percent of the total, divided largely between roads, rail, and ports, in that order. Rail accounts for 37 percent of the projected total investments and 50 percent of the uncommitted projects. Comparable percentages for roads are 41 and 31, respectively.

Table 4.5-1 shows the Consultants' estimates of available transport sector investment funds, budgeted and actual, and the estimated alternative transport sector deficits or surpluses for the 5th Plan period. The methodology for deriving these estimates of available funds is set forth in Chapter 2, Section 2.3 above. In summary, Table 4.5-1 shows transport investment requirements totalling SP 7,333 million over the 5th Plan period, compared to an estimated total budget availability of SP 7,638 million and a total expenditure availability of SP 5,187 million. This would indicate that additional investment

funds will have to be found or that some projects may have to be delayed. The table also indicates that there is a problem with fund availabilities in the early years. This is due primarily to three factors: the peaking in the early years of carry-over projects from the 4th Plan, the inclusion of most of the investment costs for an improved domestic air service in 1981, and the costs in 1981 for road betterment to correct existing deficiencies. Further study may indicate that the latter two items will need to be spread out over several years due to physical constraints on accomplishing the work in a single year.

The picture is similar with regard to the transport sector's ability to finance operations and maintenance, and investments over the 5th Plan period. Depending on the Government's policy with regard to automobile imports, the sector as a whole will require budgetary support varying from SP 1 billion to SP 3.7 billion over the period. At the same time, the sector would pay SP 1.4 billion in income taxes. Under a policy of unrestricted automobile imports, the sector would produce a slight surplus which could be used for other purposes

The investment plan shown in Table 4.5-1 is for public sector investments. It does not include investments in the motor vehicle fleet required over the 5th Plan period, since these are largely private sector investments. The Consultants' estimates of motor vehicle fleet requirements are discussed in Section 4.3.3 above, and total SP 8 billion in foreign exchange for the 1981-1985 period. Of this amount, SP 2.2 billion is for passenger cars alone.

4.5.2 Priorities

For the 5th Plan period, the Consultants recommend the following order of priorities, for the reasons given:

1. Committed projects. These are specified in the TOR.

2. Equipment needed to utilize existing and committed transport facilities. The port and rail equipment and road vehicles are essential for utilization of the facilities, given forecast demand. The mix recommended is based on the least total system cost alternative as discussed in 4.4.1 above.

3. Air navigation equipment. This equipment cannot be justified or ranked based on economic analysis. The equipment recommended is that required to bring the system up to agreed-upon international standards.

Table 4.5-1

SUMMARY RECOMMENDED TRANSPORT SECTOR PLAN, 1981-1985

	1981	1982	1983	1984	1985	Total
1. Projects Carried Forward						
Rail	410.0	390.0	380.0	300.0	220.0	1,700.0
Road	485.2	571.0	538.0	403.3	369.0	2,366.5
Civil Aviation	123.1	2.5				125.6
Ports	289.0	228.5	275.5	233.5	109.0	1,135.5
Pipeline	5.2					5.2
Total Projects Carried Forward	1,312.5	1,192.0	1,193.5	936.8	698.3	5,332.8
2. New Projects						
Rail	80.0	170.0	250.0	250.0	240.0	990.0
Road	142.0	129.4	113.8	127.5	103.3	616.0
Civil Aviation	157.7	-200.3	322.5	15.5	7.4	302.8
Ports	11.6	11.5	7.7	7.7	52.7	91.2
Total New Projects	391.3	110.6	694.0	400.7	403.[illegible]	2,000.0
GRAND TOTAL	1,703.8	1,302.6	1,887.5	1,337.5	1,101.7	7,332.8
Funds Available						
Budget	1,498.0	1,512.0	1,527.0	1,543.0	1,558.0	7,638.0
Expenditures	1,017.0	1,027.0	1,037.0	1,048.0	1,058.0	5,187.0
Transport Sector Surplus or Deficit						
Alternative A	-534.0	-462.0	-302.0	15.0	294.0	-991.0
Alternative B	-869.0	-790.0	-644.0	-344.0	-83.0	-2,730.0
Alternative C	-1,023.0	-1,007.0	-818.0	-528.0	-275.0	-3,651.0

Source: Consultants' calculations.

Note: Alternative A - Unrestricted automobile imports.
Alternative B - Automobile imports restricted to 50 percent of demand.
Alternative C - Automobile imports restricted to 25 percent of demand.

Table 4.5-2

RECOMMENDED TRANSPORT SECTOR DEVELOPMENT PLAN, 1981-1985, BY PROJECT

(1980 SP Millions)

	1981	1982	1983	1984	1985	Total
1. Rail						
General Establishment of the Syrian Railways (CFS)						
A. Project Carried Forward						
. Lattakia-Aleppo-Al Kamishli line	80.0	50.0	30.0	10.0		170.0
. Mhine-Phosphate Mines line	40.0	20.0	10.0			70.0
. Akkari-Homs-Damascus line	120.0	120.0	100.0	80.0	50.0	470.0
. Aleppo-Homs line	120.0	150.0	100.0	60.0	20.0	450.0
. Deir-Ez-Zor-Albu Kamal line	-	10.0	100.0	150.0	150.0	410.0
. Signalling and Telecommunications	50.0	40.0	40.0			130.0
Subtotal	410.0	390.0	380.0	300.0	220.0	1,700.0
B. New Projects						
. Rolling Stock	80.0	100.0	100.0	100.0	90.0	470.0
Subtotal	80.0	100.0	100.0	100.0	90.0	470.0
Total-General Establishment of the Syrian Railways (CFS)	490.0	490.0	480.0	400.0	310.0	2,170.0
General Establishment of the Hijaz Railway (CFH)		70.0	150.0	150.0	150.0	520.0
Total Rail	490.0	560.0	630.0	550.0	460.0	2,690.0

Table 4.5-2 (Continued)

RECOMMENDED TRANSPORT SECTOR DEVELOPMENT PLAN, 1981-1985, BY PROJECT

(1980 SP Millions)

	1981	1982	1983	1984	1985	Total
2. Road						
Primary Network						
A. Projects Carried Forward						
1. Damascus-Aleppo Autostrad						
Ma'loula-Homs 2nd Road	24.0					24.0
Aleppo-Saraqueb	13.0					13.0
Homs-Hama	12.0					12.0
Damascus-Ma'loula Jct.	11.0					11.0
Hama-Saraqueb, 2nd Road	37.0	37.0	37.0	37.0		148.0
Homs Bypass	9.0					9.0
Hama Bypass	2.2					2.2
Ma'loula-Homs Resurface	17.0	13.0				30.0
Subtotal	125.2	50.0	37.0	37.0		249.2
2. Second Group Autostrad						
Damascus-Jordan Border	34.0	78.0	78.0	101.0	45.0	336.0
Damascus-Lebanon Border	25.0					25.0
Tal-Kalakh Diversion	22.0	22.0	10.0			54.0
Akkari-Tartous	28.0	22.0	22.0	22.0	20.0	114.0
Tartous-Lattakia	11.0	39.0	67.0	67.0	92.0	276.0
Lattakia-Ariha	28.0	61.0	90.0	100.0	142.0	421.0
Subtotal	148.0	222.0	267.0	290.0	299.0	1,226.0
3. Aleppo-Tal Kojak						
Aleppo-Kara Kojak	15.0	22.0	28.0	34.0	17.0	118.0
Kara Kojak-Ain Issa	11.0	16.0				27.0
Kantari-Tal Tamer	17.0	22.0	10.0			49.0
Tal Tamer-Tal Alo	17.0	34.0	34.0	39.0	53.0	177.0
Tal Alo-Tal Kojak	10.0					10.0
Subtotal	72.0	94.0	72.0	73.0	70.0	381.0

Table 4.5-2 (Continued)

RECOMMENDED TRANSPORT SECTOR DEVELOPMENT PLAN, 1981-1985, BY PROJECT

(1980 SP Millions)

	1981	1982	1983	1984	1985	Total
4. Other						
Jableh-Ain Sharkieh	11.0	22.0	17.0			50.0
Nasrieh-Qariatain-Phosphate	9.0	11.0	11.0	3.3		34.3
Damascus-Baghdad	7.0					7.0
Tadmor-Deir Ez Zor	17.0	17.0	11.0			45.0
Furqlos-Phosphate	6.0	9.0				15.0
Damascus Bypass	90.0	146.0	123.0			359.0
Total	140.0	205.0	162.0	3.3		510.3
Total Projects Carried Forward	485.2	571.0	538.0	403.3	369.0	2,366.5
B. New Projects						
5. Primary roads-betterment program	34.3	43.7	6.9	13.7	12.0	110.6
6. Secondary and tertiary roads-betterment program	32.7	23.6	45.8	52.7	49.0	203.8
7. Rural Roads	75.0	62.1	61.1	61.1	42.3	301.6
Total New Projects	142.0	129.4	113.8	127.5	103.3	616.0
Total Road	627.2	700.4	651.8	530.8	472.3	2,982.5

Table 4.5-2 (Continued)

RECOMMENDED TRANSPORT SECTOR DEVELOPMENT PLAN, 1981-1985, BY PROJECT

(1980 SP Million)

	1981	1982	1983	1984	1985	Total
3. Civil Aviation						
Airports and Facilities						
A. Projects carried forward						
. Complete Damascus Terminal	33.1					33.1
. Convert terminal to freight		1.0				1.0
. High level radar	90.0	1.5				91.5
Subtotal	123.1	2.5				125.6
B. New Projects						
. Damascus						
Update Master plan	0.8					0.8
Apron extension	6.0					6.0
3 bar VASIS	1.1					1.1
Terminal modification	5.0					5.0
ILS Category I	2.5					2.5
Approach/AFL lighting	2.7					2.7
Other		13.4				13.4
Contingencies	2.8	2.0				4.8
. Aleppo						
Master plan	0.8					0.8
Pavements	12.3					12.3
Terminal/tower	23.0					23.0
Fire and rescue	6.6					6.6
VASIS/Air Navigation		3.2				3.2
AFL		3.4				3.4
Other	2.3	2.3				4.6
Contingencies	6.8	1.3				8.1

Table 4.5-2 (Continued)

RECOMMENDED TRANSPORT SECTOR DEVELOPMENT PLAN, 1981-1985, BY PROJECT

(1980 SP-Million)

	1981	1982	1983	1984	1985	Total
3. Civil Aviation (Cont'd)						
Airports and Facilities						
B. New Projects (Cont'd)						
. Other Airports						
Master plan	0.6					0.6
Pavement	5.3					5.3
Terminal	9.5	9.5				19.0
VASIS/NAVIAD		5.4				5.4
Airfield lighting			7.1	7.1		14.2
Other		6.4	6.4	6.4	6.4	25.6
Contingencies	2.3	3.2	2.0	2.0	1.0	10.5
Total New Projects	90 4	50.1	15.5	15.5	7.4	178.9
Total Airport and Facilities	213,5	52.6	15.5	15.5	7.4	304.5
Syrian Arab Airlines						
New Projects						
. Domestic Aircraft	67.3					67.3
. International Aircraft		-250.4	307.0			56.6
Total Syrian Arab Airlines	67.3	-250.4	307.0			123.9
Total Civil Aviation	280.8	-197.8	322.5	15.5	7.4	428.4

Table 4.5-2 (Continued)

RECOMMENDED TRANSPORT SECTOR DEVELOPMENT PLAN, 1981-1985, BY PROJECT

(1980 SP-Million)

	1981	1982	1983	1984	1985	Total
4. Ports and Maritime Sector						
A. Projects carried forward						
. Complete Tartous Port	123.0	107.0	99.0	101.0		430.0
. Enlarge Lattakia Port	143.0	99.0	154.0	110.0	109.0	615.0
. Complete Nucleus Fleet	22.5	22.5	22.5	22.5		90.0
. Sea wireless station	0.5					0.5
Total	289.0	228.5	275.5	233.5	109.0	1,135.5
B. New Projects						
. Tartous Port						
Minor construction and equipment	4.2	4.2	3.8	3.8	3.8	19.8
. Lattakia Port						
Minor construction and equipment	7.4	7.3	3.9	3.9	3.9	26.4
Additional Ships Syrian Navigation Company					22.5	22.5
Additional Ships Syrian-Jordanian Navigation Company					22.5	22.5
Subtotal	11.6	11.5	7.7	7.7	52.7	91.2
Total Ports and Maritime Sector	300.6	240.0	283.2	241.2	161.7	1,226.7
5. Pipelines						
Projects carried forward						
. Homs-Adra line	5.2					5.2
Total Pipelines	5.2					5.2

Source: Consultants' calculations.

4. Two new primary road links. These links are integral parts of otherwise committed projects, and each of the two shows a high economic rate of return. The rates are:

   - Lattakia-Ariha 19.2
   - Hama-Saraqueb 60.0

5. Road betterment program. Over a 40-year period, the road betterment program produces net present benefits that exceed net present costs by SP 3 billion. A nation-wide priority ranking of individual primary road sections is shown in Section 4.4.3 above. The ranking is based on the first-year return of each project.

6. New secondary and tertiary roads. The Syrian paved road network has doubled in the last 10 years, and 32 percent of the network currently has average daily traffic volumes of less than 400 vehicles per day. These facts support the conclusion that secondary and tertiary road construction in the 5th Plan period should consist of upgrading existing earth roads to gravel standards and the construction of 1,045 kilometers of new gravel rural access roads. (The supporting analysis is presented in Volume IV, Chapter 3.) Analysis of the benefits of improved or additional rural acess roads must be done on a link-by-link basis. The preferred methodology is an analysis of development potential in the area influenced by the road. Even if the requisite data were available, the level of analysis would be beyond the scope of a national transport study. Studies elsewhere indicate that rural access roads can have a significant social and economic development impact. However, in the absence of specific benefit data, the Consultants consider that rural access roads, as a group, should have a lower priority than the paved road betterment program with its high net present benefits over costs.

7. Domestic air service. If necessary infrastructure improvements at domestic airports are included, the net present value of costs for a domestic air service substantially exceeds benefits. The system as a whole can be justified only on socio-political grounds.

4.5.3 Road Betterment and Maintenance

Details on the preliminary recommended financial investments for other modes are set forth in preceding sections of this chapter and in the modal volumes of this report. This section summarizes the proposed investments for road betterment and the forecast maintenance costs.

The 1981 through 1985 financial investment cost of the primary road betterment program and the estimated primary road maintenance costs, by Mohafaza, and for the whole country, are shown in Table 4.5-3. Width and surface condition deficiencies in the primary network have been evaluated for the 1981 through 1985 period. Maintenance costs were derived from forecast pavement deterioration based on projected average daily traffic. The network evaluated is in the existing 1979 network plus projects to be constructed during the 5th Five-Year Plan period. A detailed discussion of the methodology is presented in Section 4.4. above.

In summary, the total cost is SP 225 million (betterment SP 110 million, or 49 percent, and maintenance SP 115 million, or 51 percent).

Table 4.5-4 shows the 1981-1985 financial investments for the road betterment program and the estimated maintenance costs for secondary and tertiary roads by Mohafaza and for the country as a whole. The methodology is the same as that used for primary roads, applied to the existing network.

In summary, the total cost is SP 393 million (betterment SP 204 million, or 52 percent, and maintenance SP 189 million, or 48 percent).

4.5.4 Probable Transport Investment 1986-2000

The Consultants' forecast of probable investment requirements for the transport sector for the period 1986-2000, by plan period, is summarized in Table 4.5-5. Supporting details are contained in the modal volumes of this report.

Table 4.5-3

FINANCIAL COSTS OF PRIMARY ROAD BETTERMENT/MAINTENANCE PROGRAM, 1981-1985

Mohafaza	Type of Operation	1981	1982	1983	1984	1985	Total
Damascus	Resurfacing	1,208	5,908	238	702	2,905	10,961
	Widening	81	771	140			992
	Betterment Total	1,289	6,679	377	702	1,905	11,953
	Maintenance	2,276	2,294	2,317	2,344	3,088	12,319
	Total	3,565	8,973	2,694	3,047	5,993	24,272
Aleppo	Resurfacing	6,326	5,729				12,056
	Widening		4,174	197			4,371
	Betterment Total	6,326	9,904	197			16,427
	Maintenance	2,528	2,517	2,510	2,519	3,070	13,144
	Total	8,855	12,421	2,707	2,519	3,070	29,571
Homs	Resurfacing	1,270	1,465	1,777	775		5,287
	Widening		195	86	1,745	401	2,426
	Betterment Total	1,270	1,659	1,863	2,520	401	7,713
	Maintenance	3,786	3,811	3,845	3,817	5,613	20,873
	Total	5,056	5,471	5,708	6,337	6,014	28,586
Hama	Resurfacing	3,671	3,117				6,787
	Widening			889	1,905		2,793
	Betterment Total	3,671	3,117	889	1,905		9,580
	Maintenance	1,545	1,533	1,541	1,553	1,921	8,093
	Total	5,216	4,649	2,429	3,457	1,921	17,673
Lattakia	Resurfacing	585			5,668		6,253
	Widening		1,855				1,855
	Betterment Total	585	1,855		5,668		8,108
	Maintenance	842	831	826	825	1,320	4,644
	Total	1,427	2,686	826	6,493	1,320	12,751

Table 4.5-3 (Continued)

FINANCIAL COSTS OF PRIMARY ROAD BETTERMENT/MAINTENANCE PROGRAM, 1981-1985

Mohafaza	Type of Operation	1981	1982	1983	1984	1985	Total
Deir Ez Zor	Resurfacing	2,917	2,262				5,179
	Widening	124					124
	Betterment Total	3,041	2,262				5,303
	Maintenance	1,341	1,329	1,321	1,316	1,399	6,706
	Total	4,382	3,591	1,321	1,316	1,399	12,009
Idleb	Resurfacing	1,293	787	1,847	2,671	8,691	15,289
	Widening	8,241	682				8,924
	Betterment Total	9,535	1,470	1,847	2,671	8,691	24,213
	Maintenance	2,394	2,395	2,383	2,385	2,490	12,047
	Total	11,929	3,864	4,230	5,056	11,181	36,260
Al Hassakeh	Resurfacing	3,305	3,494				6,799
	Widening		10	10			20
	Betterment Total	3,305	3,504	10			6,820
	Maintenance	2,052	2,078	2,109	2,133	3,189	11,561
	Total	5,357	5,583	2,120	2,133	3,189	18,380
Al Raqqa	Resurfacing	1,427	3,623				5,050
	Widening						
	Betterment Total	1,427	3,623				5,050
	Maintenance	1,194	1,173	1,160	1,150	2,425	7,102
	Total	2,621	4,796	1,160	1,150	2,425	12,151
Al Suweida	Resurfacing	1,609	3,543				5,151
	Widening	53	225	160	221		659
	Betterment Total	1,662	3,768	160	221		5,810
	Maintenance	720	729	738	749	762	3,698
	Total	2,382	4,497	898	970	762	9,508

Table 4.5-3 (Continued)

FINANCIAL COSTS OF PRIMARY ROAD BETTERMENT/MAINTENANCE PROGRAM 1981-1985

Mohafaza	Type of Operation	1981	1982	1983	1984	1985	Total
Dera'a	Resurfacing	1,046	2,027				3,073
	Widening			34			34
	Betterment Total	1,046	2,027	34			3,108
	Maintenance	1,084	1,073	1,057	1,045	1,771	6,030
	Total	2,130	3,100	1,091	1,045	1,771	9,137
Tartous	Resurfacing	980	754	1,134			2,868
	Widening		1,798	367	4		2,169
	Betterment Total	980	2,552	1,501	4		5,036
	Maintenance	1,095	1,102	1,114	1,128	1,675	6,114
	Total	2,074	3,654	2,615	1,132	1,675	11,150
Quneitra	Resurfacing	177	1,261				1,438
	Widening						
	Betterment Total	177	1,261				1,438
	Maintenance	487	491	496	502	508	2,484
	Total	664	1,752	496	502	508	3,921
All Country	Resurfacing	25,813	33,970	4,995	9,816	11,596	86,190
	Widening	8,500	9,710	1,882	3,874	401	24,368
	Betterment Total	34,314	43,680	6,877	13,690	11,997	110,558
	Maintenance	21,344	21,357	21,417	21,465	29,230	114,813
	Total	55,657	65,037	28,294	35,155	41,227	225,371

Source: Consultants' estimates.

Table 4.5-4

FINANCIAL INVESTMENT PLAN
SECONDARY AND TERTIARY NETWORK
(1980 SP millions)

Mohafaza and Type of Investment/ Cost	5th Five-Year Plan Period					
	1981	1982	1983	1984	1985	Total
Damascus						
Betterment	22.1	9.1	4.0	17.8	2.6	55.6
Maintenance	6.6	6.6	6.7	6.8	6.9	33.6
Aleppo						
Betterment	0.2	1.5	-	5.9	13.4	21.0
Maintenance	3.4	3.4	3.5	3.5	3.6	17.4
Homs						
Betterment	-	-	12.9	2.2	1.9	17.0
Maintenance	2.2	2.2	2.2	2.3	2.3	11.2
Hama						
Betterment	8.8	7.1	15.8	7.4	5.4	44.5
Maintenance	3.9	4.0	4.1	4.2	4.3	20.5
Lattakia						
Betterment	1.5	2.8	2.3	7.6	5.0	19.2
Maintenance	4.7	4.8	4.9	5.0	4.9	24.3
Deir Ez Zor						
Betterment	-	-	-	-	-	-
Maintenance	0.9	0.9	0.9	0.9	0.9	4.5
Idleb						
Betterment	-	0.2	-	6.3	15.1	21.6
Maintenance	2.4	2.4	2.5	2.5	2.6	12.4
Al Hassakeh						
Betterment	-	1.4	-	0.5	0.1	2.0
Maintenance	1.5	1.6	1.6	1.6	1.6	7.9
Al Raqqa						
Betterment	-	-	-	-	-	-
Maintenance	1.2	1.3	1.3	1.3	1.3	6.4

Table 4.5-4 (Continued)

FINANCIAL INVESTMENT PLAN
SECONDARY AND TERTIARY NETWORK
(1980 SP millions)

Mohafaza and Type of Investment/Cost	5th Five-Year Plan Period					
	1981	1982	1983	1984	1985	Total
Al Suweida						
Betterment	-	-	0.4	2.1	5.6	8.1
Maintenance	2.5	2.6	2.6	2.7	2.7	13.1
Dera'a						
Betterment	-	-	2.3	0.7	-	3.0
Maintenance	2.3	2.3	2.4	2.5	2.5	11.9
Tartous						
Betterment	-	1.5	8.1	2.1	-	11.7
Maintenance	5.0	5.1	5.2	5.4	5.2	25.9
Country Total						
Betterment	32.7	23.6	45.8	52.7	49.0	203.8
Maintenance	36.5	37.1	37.9	38.6	38.9	189.0
GRAND TOTAL	69.2	60.7	83.7	91.3	87.9	392.8

Source: Consultants' estimates.

Table 4.5-5

PROBABLE LONG-RUN TRANSPORT SECTOR INVESTMENTS, 1986-2000
(1979 SP millions)

	1986-1990	1991-1995	1996-2000	Total
1. Rail				
A. Line Capacity Improvements				
CFH	310			310
Damascus-Mhine		290		290
Mhine-Homs	13	128		141
Jibrine-Al Raqqa			38	38
Homs-Vodehi			20	20
Wadihi-Lattakia			35	35
B. Rolling Stock	500	632	577	1,709
C. Other	225	240	250	715
Total Rail	1,048	1,290	920	3,258
2. Road				
A. Primary Network				
New Roads				
Hama-Al Salamieh-Al Raqqa			233	233
Aleppo Bypass		87		87
Tadmur-Albu Kamal			340	340
Betterment	153	274	383	810
B. Secondary and Tertiary Network				
New Paved Roads	38	38	38	114
Betterment	335	428	546	1,309
Rural Roads	88	88	88	264
Total Road	614	915	1,628	3,157

Table 4.5-5 (Continued)

PROBABLE LONG-RUN TRANSPORT SECTOR INVESTMENTS, 1986-2000
(1979 SP millions)

	1986-1990	1991-1995	1996-2000	Total
3. Civil Aviation				
A. Airports				
Damascus	111	79	79	257
Aleppo	33	33		66
Lattakia		8		8
Deir Ez Zor		34		34
Total Airports and Facilities	144	142	79	365
B. Syrian Arab Airlines				
International Aircraft	314	314	314	942
Domestic Aircraft	67		67	134
Total Syrian Arab Airlines	381	314	381	1,076
Total Civil Aviation	525	456	460	1,441
4. Ports				
Tartous	22	20	20	62
Lattakia	17	15	15	47
Additional Ships	226	226	226	678
Total Ports and Maritime	265	261	261	787
5. Pipeline				
Homs-Adra Line		109		109
Homs-Al Raqqa Line		105		105
Total Pipelines		214		214
Grand Total	2,452	3,136	3,269	8,857

Source: Consultants' estimates.