Chapter 7

Demand Forecast

Chapter 7 Demand Forecast

7.1 Implementation Methodology

The workflow for the demand forecast practice is divided into four tasks, which are subsequently divided into 13 sub-tasks as shown in Figure 7.1.1. For all the tasks the data for 10 years was collected. The ten-year period was selected because during that period the Syrian economy has been gradually changing from a centrally planned economy to a free market one. There are two zoning systems; large zones which confirm to the administrative governorates boundaries, and small zones which group a number of main stations. The road transport OD has been prepared based on the traffic counts at stations on the governorate borders. The rail transport OD has been prepared based on the GESR data concerning transport between the stations. In addition the pipeline OD and air transport OD have been prepared on the basis of the pipeline and air networks respectively. The UN classification for commodities has been adopted in this study with some minor adjustment to reflect certain conditions particular to Syria.

Production, generation and attraction volumes were calculated for passengers only, while for the commodities the production and consumption amounts were calculated in a different way. Trip distribution followed the present pattern because of the following reasons:

a. No drastic changes in the land use pattern in Syria are anticipated
b. Amount changes in the 32 commodity types are reflected in the OD table

Based on the results of a separate survey the passenger transport modal split model was prepared. For the freight transport, another survey revealed that the main criteria for mode selection was the minimum cost and accordingly the modal split model was prepared.

The future indicators were mainly produced from the econometric model and the population model. In addition a sub-model was developed to forecast supplementary indicators.

Assignment of the traffic was done on the basis of the small zones. In the freight OD and in the passenger OD, pipeline transport and air transport respectively were treated independently. The modal split model was used to assign the passengers traffic on the bus and rail modes and the freight traffic on the truck and rail modes.

The workflow is briefly described in the Figure 7.1.1. Details of the work are voluminous and are represented in the Appendix under the same chapter numbering.

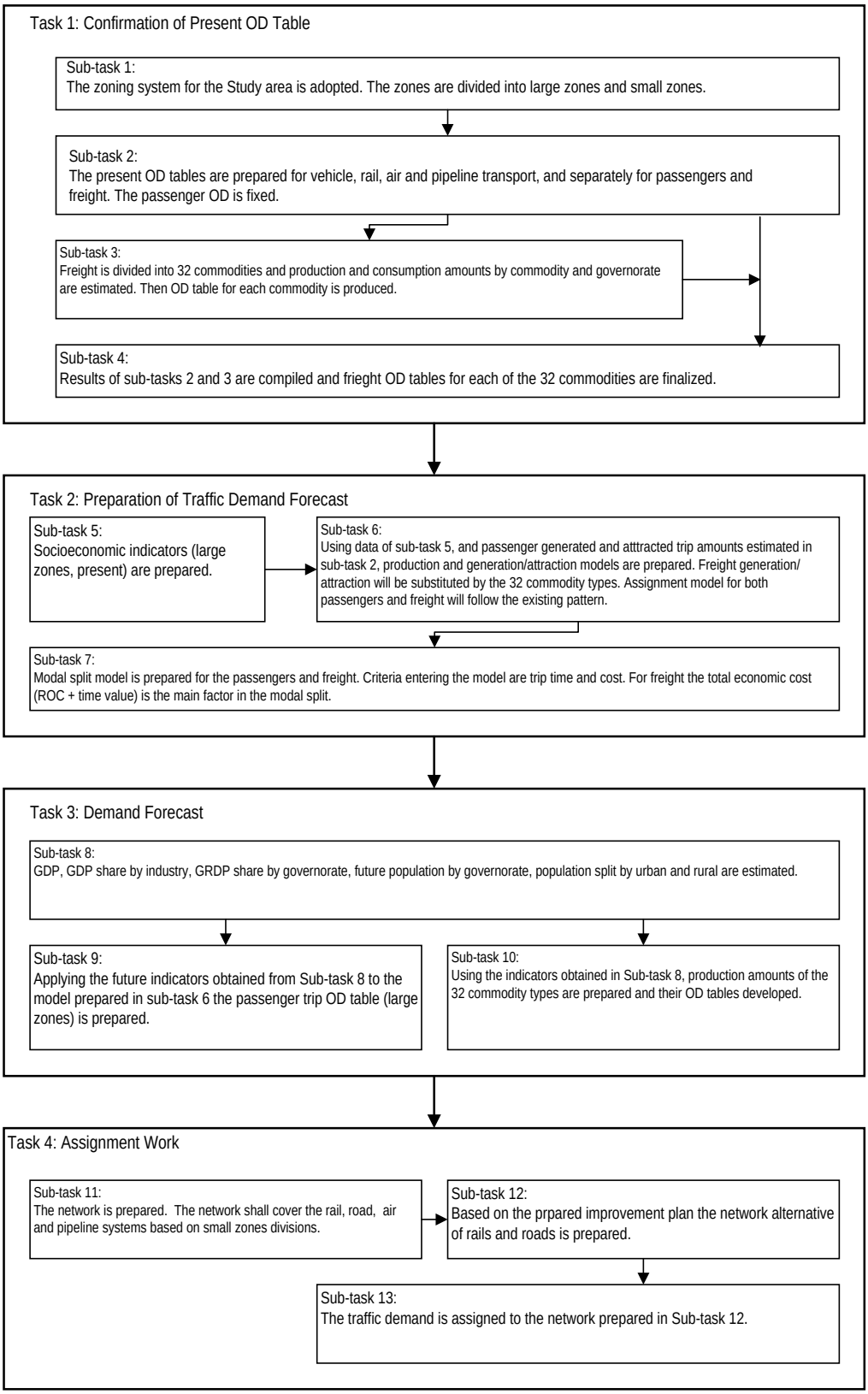


Figure 7.1.1 Flow Chart for Demand Forecast Work

7.2 Zoning and Indices of Zone

7.2.1 Zoning

(1) Large Zones

The boundaries of the large zones correspond to the Governorate boundaries in order to facilitate data collection. Outer zones are Turkey, Iraq, Jordan, Lebanon and the Mediterranean Sea and each of these zones represent the traffic from other countries passing through them respectively as well as the traffic from them.

(2) Small Zones

The small zones correspond to major stations and their spheres of influence. Stations include those along the planned lines as well. Areas outside the railways' sphere of influence are considered as one zone. Large and Small zones are shown in Figure 7.2.1 and are tabulated in Appendix Table 7.2.1.

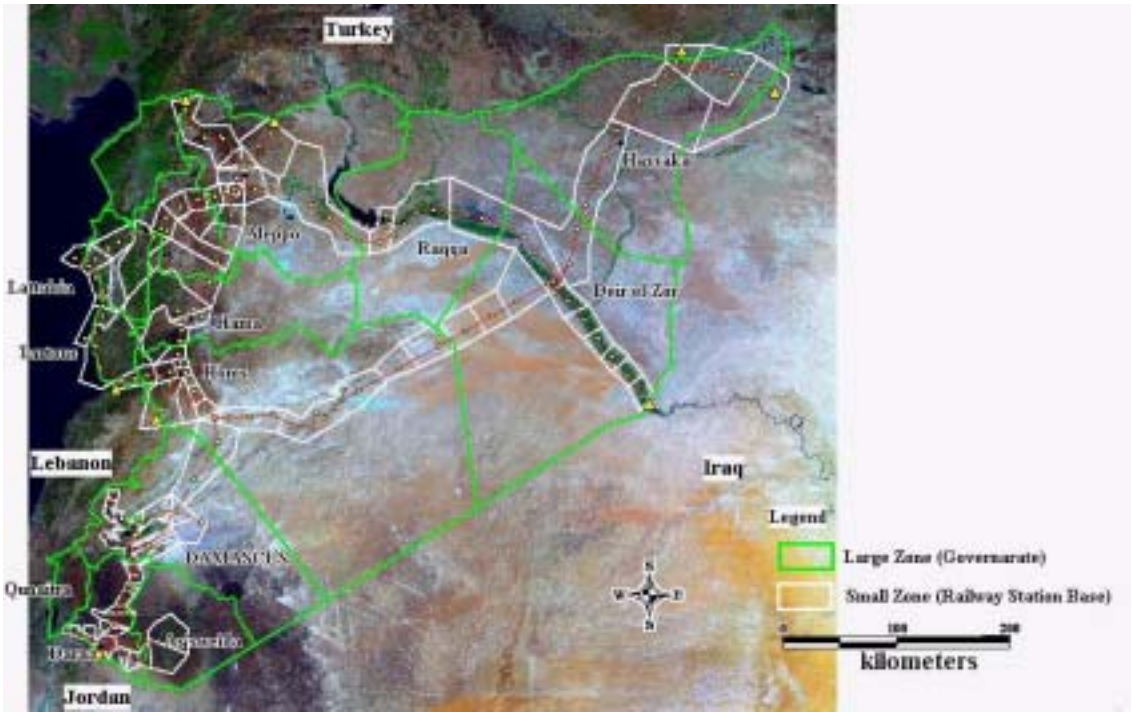


Figure 7.2.1 Large and Small Zones Map

7.2.2 Indices of Zones

(1) Large Zones

Indices of large zones were used for projection of production of passenger trips and their generation and attraction. The Statistical Abstract only provides population on governorate basis and the 1998 Labor Survey reports on the numbers of laborers by industry. Estimation of GRDP by Industry, population and indices of urbanization were done in the following steps.

GRDP

a) Productivity of each industrial sector for 1994 and 1998 was calculated from the 1999 Statistical Abstract.

b) Numbers of laborers in each Governorate classified by industrial sector for 1994 and 1998 were obtained from the reports of Labor Surveys of 1994 and 1998.

c) Reliability of 1998 data (reported as draft) was examined through comparison with the 1994 settled data and confirmed. Between these two years it was separately confirmed that there were no major economic changes and growth rates and shares by governorate and industry were examined and it was confirmed that there were no exceptional values.

d) Numbers of laborers by industry sector obtained from the Labor Survey Report (sample survey) were expanded using 1999 Statistical Abstract.

e) The 1998 GRDP was obtained as a product of a) and d)

f) Share of Governorate in each sector GDP for 1998 was obtained from e).

g) GDP up to 2020 was projected using the Econometric Model.

h) GDP by Sector up to 2020 was projected using regression models developed separately.

i) Output of h) is controlled by GDP projected in the step g) (regulated by formula GDP of

g) / Sum of h)).

Population

a) Population of each Governorate in 1998 was obtained from the 1999 Statistical Abstract.

b) Growth rate of population of each Governorate was also obtained from the 1999 Statistical Abstract.

c) Population of each Governorate after 2000 and up to 2020 was obtained from a) and b).

d) Total population of each year was obtained from the Population Model described in Chapter 6, section 2.

e) Output of c) is controlled by d) (regulated by formula population of d) / Sum of c)).

Indices of Urbanization

Quotients produced by sets of several sector GRDP groups (e.g. (GRDP of wholesale and retail)/(GRDP of agriculture) were prepared and used.

Indices of large zones are listed in Appendix Table 7.2.2.

(2) Small Zones

The basic OD data of this study is the OD table estimated from car traffic crossing Governorate borders. In other words the basic OD is based on the large zones but the modal split model of passengers and freight are functions consisting of trip time and trip cost. Trip time and trip cost are related to distance between one small zone to another small zone. Therefore, dispersion of large zone trips to small zones becomes necessary.

Excluding population data for rather large local cities, no data is available on a small zone base. The Study Team interpreted zone characteristics; residential areas and green areas from a satellite photographic image, major factories classified by 32 commodity types (explained later), and oil/gas fields and mines located on the small zone. Indicators on small zones are illustrated on Figure 7.2.2.

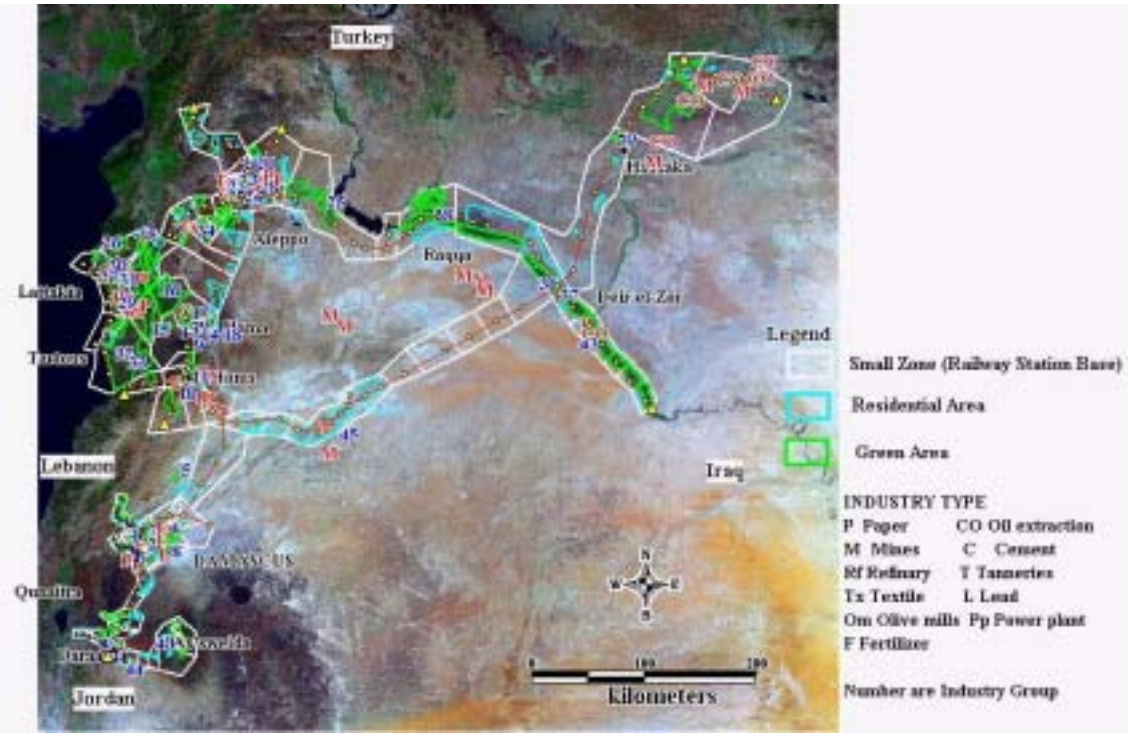


Figure 7.2.2 Indicators of Small Zones

7.3 Road Transportation (2000)

7.3.1 Traffic Counts at the Roads crossing Zone Borders

(1) Traffic Counts

Major roads have traffic count data but survey points are limited in number. The Study Team executed supplementary surveys such as:

- Rate of loading by truck type,
- Average number of passengers by vehicle type, and
- Traffic counts at some locations as necessary.

Survey points of the Ministry of Communication and those of the Study Team are illustrated in Appendix Figure 7.3.1, and other data are summarized in Appendices of Chapter 7.

(2) Simplified Road Network

The simplified road network (the network connecting a zone with an adjacent zone by only one road) was prepared in order to estimate the vehicle OD. The simplified road network with assigned vehicle traffic is shown in Figure 7.3.2.

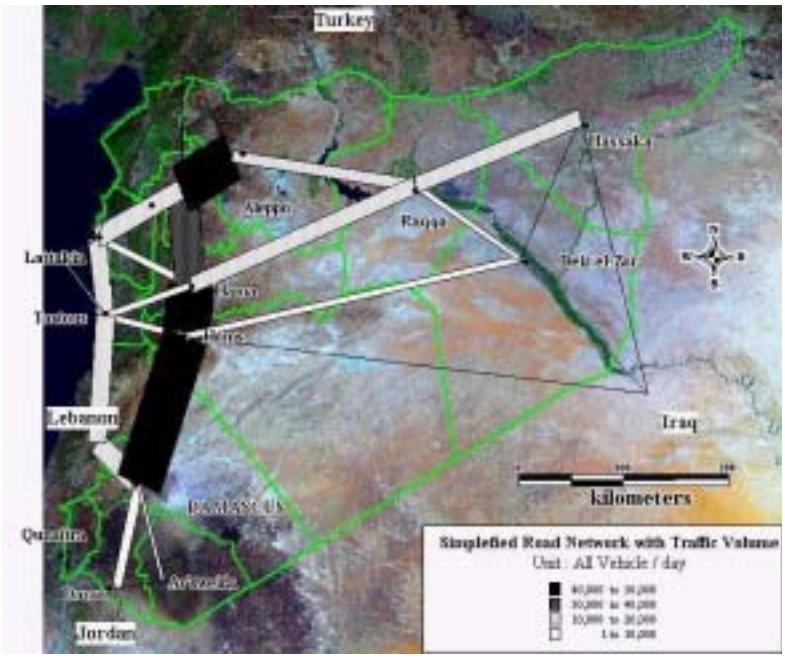


Figure 7.3.2 Traffic Volume assigned on Simplified Road Network

7.3.2 Road Transport OD (Large Zone)

The OD Table estimated from traffic counts described earlier is obviously the OD for the large zones. Steps to estimate the said OD volume were as follows:

a) A simplified maximum entropy method was used to obtain the OD tables. For this purpose the total traffic volumes crossing all the zones of the simplified network described in section 7.3.1 (2) are necessary.
b) In principle the zone crossing traffic volumes were obtained from the Ministry of Communication survey points. In cases where there were no traffic volume data at a crossing point or where the data of the Ministry of Communications was incomplete, the Study Team made supplementary surveys and made some modifications based on the survey results.
c) Upon inputting the 24-hour traffic volumes by vehicle classification and by direction on the assumed link routes, the simplified maximum entropy method is run and the OD data for the 18 zones for a 24-hour period by vehicle classification is produced.
d) The average vehicle passenger occupancy rates and average freight loading rates obtained from the supplementary surveys are then applied to each OD pair by vehicle classification and the passengers and freight for the OD pairs of the 18 zones is obtained.
e) The results were then assigned to the simplified network and the present network (the national road network in Syria). It was confirmed that there were no large differences between the assignment results and the traffic volumes surveyed at the roadside survey points.

7.4 Railways Transportation (2000)

7.4.1 Railway Network

GESR and GEHR networks with major station names are shown in Figure 7.4.1. GESR has many branch lines to connect to Silos and Factories. Figure 7.4.1 also includes the planned routes.

Figure 7.4.1 Railway Network

7.4.2 Rail Transport OD

Transport records of GESR from one station to another for 1998 and 1999 were obtained. Rail transport OD of passenger and freight were compiled from these data. The Study Team could not obtain any transport records from GEHR. Consequently the OD at present between GEHR stations are zero excluding transport from GESR to GEHR station. Figures 7.4.2 and 7.4.3 show passenger movement and freight movement, respectively.

The largest passenger traffic was observed along the Lattakia – Aleppo route with about 1,000 to 1,500 passengers per day. The road between these two cities is low in quality (maintenance conditions are considered poor as shown in Chapter 2) and this may account for this railway volume. In terms of freight transport the largest volumes were observed along the Mhine – Homs and Homs – Tartous and Homs – Hama routes. Phosphates and petroleum products ac-

count for most of commodities transported. On the other hand agricultural products are heavily transported on the Hassaka – Deir el-Zor – Raqqa and Aleppo route, and southwards to Damascus.

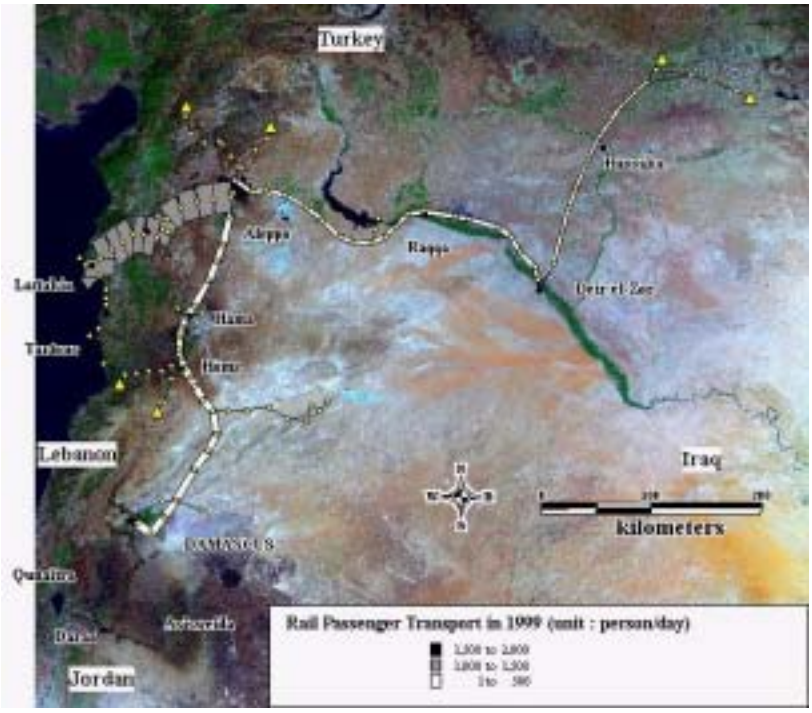


Figure 7.4.2 Rail Passenger Transport

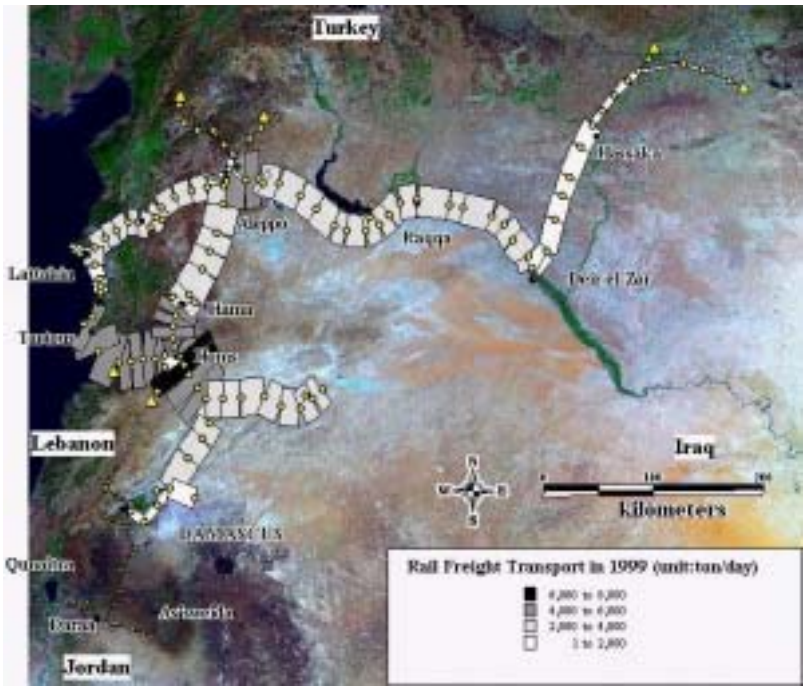


Figure 7.4.3 Rail Freight Transport

7.5 Total OD (Large Zone, 1999)

7.5.1 Passenger

Road passenger OD obtained from road traffic observation at the Governorate borders and Rail passenger OD represent the OD traffic between one governorate and another. Passenger OD terminated in the same Governorate is estimated using the results of agricultural zones of the Home Interview Survey done at the Damascus Urban Transport Study, JICA 1997-1999. Passenger OD (Large Zone) is given in the Appendix and traffic assignment on the present network is shown in Figure 7.5.1.

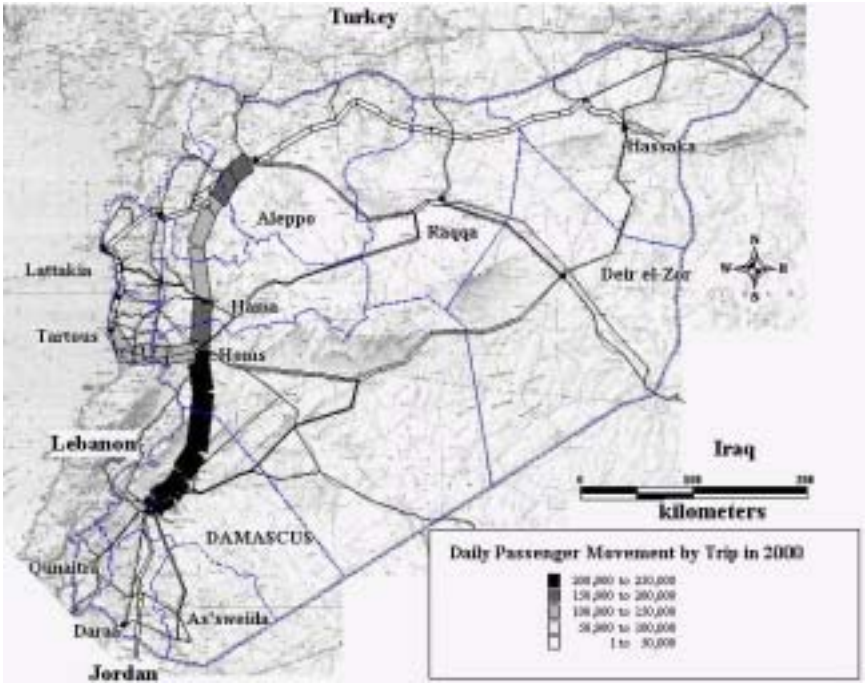


Figure 7.5.1 Passenger Traffic Assignment on Present Network

7.5.2 Freight

Production/consumption tables were prepared from statistical data and hearings from related agencies. Production and consumption is equivalent in meaning to generation and attraction represented in the OD table. The procedure to obtain the large zone OD table was as follows;

a) Commodity items of the Statistical Abstract were examined and 32 comprehensive commodities were chosen as representative items.

b) In the step of aggregation from original items to 32 commodity types, commodity production, export and import amounts were unified to ton base.

c) The production/consumption tables for the 32 commodity types were obtained.

d) The Fratar method was applied to the 32 commodity types production/consumption tables and the OD tables (large OD base) were obtained by commodity item.

e) Freight OD (Large Zone) is given in the Appendix and traffic assignment on the present network is shown in Figure 7.5.2.

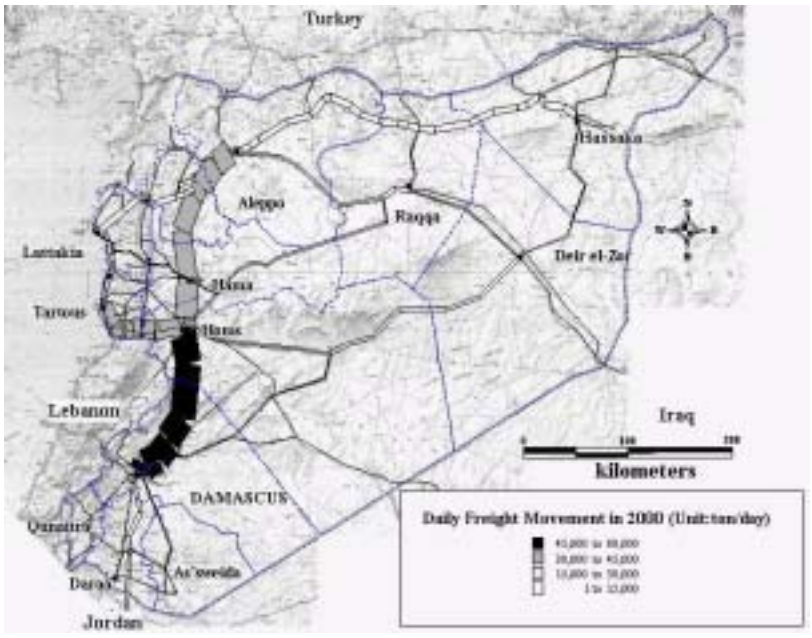


Figure 7.5.2 Freight Traffic Assignment on Present Network

7.6 Model

7.6.1 Trip Production Model

There are two trip production units, namely trip production unit estimated from vehicle counts crossing governorate borders (inter large-zonal trip production unit) and trip production unit on the analogy of trip production unit of agricultural zones in the Damascus Urban Transport Study person trip survey (intra large-zonal trip production unit). The former unit is 29.8 trips per 1,000 persons and the latter is 0.437 trips per person (inner large-zonal trips only). In the following calculations for the large zones passengers OD pairs the trip production rate of 0.0298 trip/person shall be used for intra-zonal trip production rate and the figure of 0.437 trip/person is used for intra-zonal trip production rate.

Trip Production and Trip Generation/Attraction Models of Freight are not prepared due to existence of the production/consumption projection.

7.6.2 Trip Generation/Attraction Model

For the trip generation and attraction model between governorates the parameters applied are the population, urbanization indicators ((secondary industry GDP + tertiary industry GDP) / primary industry GDP), seaport region flag (seaport region flag 1, other regions 0). Furthermore the amount of generated and attracted traffic for each zone OD pair is the same in terms of going and return traffic. Due to this, the generation and attraction models are the same type.

$$TRIPga = 0.01566 \times POP + 521.4 \times UBN + 20{,}353.0 \times PORT + 6053.2$$

$(R^2 = 0.924)$

Legend TRIPga : Trip Generation/Attraction
POP : Governarate Population
UBN : Urban Indicator
PORT : Seaport Flag

7.6.3 Trip Distribution Model

The passenger trip distribution model has been done in two steps: between large zones and between small zones. The present pattern was used for distributing traffic between the large zones, because it is assumed that there will be no significant changes in the land use in Syria up to the year 2020 (development will continue while maintaining balance of the present inter-regional conditions).

The traffic of the large zones was distributed amongst the small zones based on the analysis of satellite photographs in order to determine each station weight through its surrounding urbanized area (passengers) or based on the present pattern (freight).

7.6.4 Modal Split Model

(1) Passenger

The modal split was first done for the air and passenger car transport modes, and the remaining traffic demand was then divided amongst the bus and rail transport modes. The growth of air passengers has been projected by means of a regression model with GDP/Capita as the independent variable. The results are shown in Table 7.6.9.

Table 7.6.9 Forecast of Domestic Air Transport Passengers

Year	2000	2005	2010	2015	2020
Air transport passengers	302,015	438,382	648,201	971,033	1,467,750

The number of passenger car users was estimated using the present estimates and applying the expected growth in passenger car number. In the estimation equation the passenger car/capita was well defined by the GDP/capita as the variable (P-Car/Cap = 0.651238 x GDP/Cap - 5.96306, $r^2 = 0.88$).

Table 7.6.10 Rate of Increase of Car Transport

Year	Number of passenger cars	Increase to year 2000
2000	413,009	1.0000
2005	604,276	1.4631
2010	899,513	2.1780
2015	1,354,203	3.2789
2020	2,058,933	4.9852

The modal split for bus and rail was done as described hereafter.

Survey

Interviews to 50 train passengers at Al Kadam Terminal Station (Damascus) and 50 bus passengers at Al Kaboun Long Haul Bus Terminal (Damascus) were executed in May of 2000. Question items were as follows;

a. Trip times of major transport, transport for access and transport for egress;
b. Trip costs of major transport, transport for access and transport for egress;
c. Type of transport of major transport, transport for access and transport for egress;
d. Distance of major transport, transport for access and transport for egress;
e. Service frequency of major transport, transport for access and transport for egress;
f. Attributes of the trip; trip purpose, trip origin, trip destination, with child/children (number of children accompanied), with heavy/large or many pieces of baggage (number of baggage),
g. Attributes of the passenger; age, sex, occupation, handicapped or not, car ownership,
h. Reasons why this transport mode was chosen.

The answers why the interviewees chose bus or train are summarized in Table 7.6.11.

Table 7.6.11 Major Reasons for Selection of Train/Bus Modes

Reason	Train Passenger	Bus Passenger
Safe including “Can sleep”	24	0
Cheap	11	0
Destination is near from station	14	5
Fast	0	22
Comfortable	6 (can smoke 4)	7

Controllable variables in Table 7.6.11 are fare and speed. Converted time of travel cost was formulated as (1) using the said 100 samples on difference of travel time of two transport modes (train and bus) and difference of travel cost (fare).

$$-0.0349 \times TT + 0.02768 \times TC + 3.031829 = 0 \quad \text{.....(1)}$$

Where, TT = difference of travel time (Train - Bus, minutes)

TC = difference of travel cost (Train - Bus, Syrian Pound)

From Equ. (1)

TT = 0.7931 x TC +86.8719 …. (2)

The conversion rate due to improvement of the railway is obtained from the conversion curve developed by US Highway Research Board, which is

$CR (\%) = 100/(1+t^6)$ …….. (3)

Where, t = (required time of new route / required time of old route).

Assuming "required time of new route" is train travel time (TTT) + converted time of travel cost difference (TC) using Equ. (2), and "required time of old route" is bus travel time (BTT), then Equ. (3) becomes:

$CR (\%) = 100 / (1 + ((TTT + 0.7931TC + 86.8719) / BTT)^6)$ ….. (4)

Zone Characteristic Model

Rates of number of daily bus passengers over number of train passengers of each large zone pair were calculated. Rates were explained by travel time difference, travel cost difference and zone dummy variables that express zone characteristics. This model was used for calibration of the result of the Modal Split Model.

(2) Freight

The pipeline transport amount was considered independently from the freight transport. The pipeline network transports total amount of crude oil and natural gas, and a part of the petroleum products and the remaining transport demand within the large zones are transported by the trucks. Subsequently trucks and rail modes shall compete for the transport demand between the large zones only.

In preparing the modal split model for the freight transport it was first necessary to analyze the present transport conditions and the circumstances, mostly administrative under which these conditions came about. There is the principle that the rail transport has priority over other transport modes. It first appeared in an official order decreed by the prime minister in 1987. This principle was enforced by a number of decrees as explained hereafter.

- November 1987: All exports and imports related to the public sector shall be transported by rail (Prime Minister decree)

- July 1997: All agencies and organizations belonging to the Ministry of Transport shall as much as possible transport their freight by rail (Prime Minister decree)

- July 1993: Notice from the Ministry of Transport addressed to the ministries of economy and foreign trade, supply and internal trade, agriculture and industry informing them that the GESR facilities are in place to support the cabinet decision to transport all their freight by rail.

Recently there is a move within the government to shift from the planned transport system to the competitive system whereby rail transport would compete with other transport modes in freight transport. In recent statements, the new Syrian government has stressed the importance of shifting to a market oriented economy on a competitive basis.

Under the conditions of free competition between truck and rail transport it is important to consider how the consignors have evaluated rail transport so far in order to anticipate their continued use of this mode. The Study Team has made some interviews with selected major consignors to hear their opinions, which are described below.

- Petroleum products: Delays in rail transport are now the norm. Delays are in the range of 3 days to one week. In the case of transport from Homs the distance by road is shorter and consequently transport cost is cheaper by road.

- Phosphate: All mined phosphate ore is transported by rail. Ore is transported from the mines to the ports of export and there are no problems in rail transport.

- Cereals, cement, metal products: Problems of rail transport are delays (1 week to 10 days). For areas served by branch lines problems are less, but in general preference is to use trucks.

Although there is a planned economy in the transport sector, this is actually in name only.

The actual freight transport conditions can be understood from the GESR data.

Consignors notify GESR at the start of the year the amount of freight they intend to transport by rail. GESR compares these amounts to the actual amounts they have transported until the end of the year. These data can indicate which consignors willingly use rail transport (actual amount transported/planned amount = high) and those that prefer to use truck transport (actual amount transported/planned amount = low). The results, compiled in Table 7.6.12 show that with the exception of phosphates rail transport, it is more preferable by consignors to transport most commodities by trucks.

Table 7.6.12 Freight Transport Achievement Rate (unit: ton)

Commodity type	Planned transport amount	Actual transport amount	Achievement rate
Petroleum products	10,954,000	462,934	0.04
Construction materials/ cement	8,563,000	715,143	0.08
Phosphate ore	2,574,000	3,416,462	1.33
Metal (primary products)	3,817,000	204,912	0.05
Agricultural goods	16,713,000	835,216	0.05
Industrial goods	12,532,000	573,411	0.05

Source：GESR

In the case of freight, if delay in delivery time is permissible it is then common practice to determine the modal split based on the optimum cost. The trade off between delay of delivery and transport cost becomes the actual issue. Based on these premises, the railway freight share model is formulated as follows:

Railway freight modal share $= m_{jk} \times f(n_i) \times (100/(1 + (RTC/TTC)^6))$

where, m_I: Freight transport achievement rate of commodity I

n_I: Days of delay of commodity

RTC: Railway transport tariff (in SP)

TTC: Truck transport tariff (in SP)

The f(n) depends on the commodity i. General pattern of f(n) is as follows;

Table 7.6.13 General pattern of f(n)

Travel Time of Truck - Travel Time of Train	f(n)
Less than (or equal to) 6 hrs	1
More than 6 hrs and less than (or equal to) 24 hrs	0.5
More than 24 hrs and less than (or equal to) 36 hrs	0.25
More than 36 hrs and less than (or equal to) 48 hrs	0.1
More than 48 hrs	0

7.7 Demand Forecast

7.7.1 Zonal Indices (Years 2000, 2005, 2010, 2015 and 2020)

(1) Large Zone (Passenger)

The indicators of the passenger attraction and generation model are shown in Table 7.7.1 for population, followed by Table 7.7.2, which shows the indicators by urbanization degree. In terms of indicators by regional characteristics Lattakia and Tartous, with seaports are attached the figure 1 as a dummy variable, while the remaining governorates are attached the figure 0.

Table 7.7.1 Passenger Generation/Attraction Model Indicators 1 (population)

Population	2000	2005	2010	2015	2020
Damascus	3,584,266	4,266,311	5,294,311	6,879,901	9,157,240
Aleppo	3,566,549	4,272,706	5,313,723	6,891,485	9,118,363
Homs	1,415,916	1,659,883	2,020,006	2,563,544	3,319,059
Hama	1,273,089	1,488,834	1,807,459	2,288,253	2,955,463
Lattakia	823,571	928,616	1,086,941	1,326,749	1,652,181
Deir el-Zor	896,149	1,113,100	1,435,234	1,929,855	2,647,358
Idlib	1,076,114	1,281,220	1,583,522	2,040,976	2,683,721
Hassaka	1,202,499	1,419,972	1,740,645	2,225,120	2,901,903
Raqqa	662,230	792,650	984,893	1,276,174	1,687,006
As'sweida	295,269	331,955	387,415	471,505	585,439
Daraa	747,522	913,903	1,159,877	1,535,099	2,072,749
Tartous	640,510	716,228	831,403	1,006,434	1,242,924
Qunaitra	63,316	80,623	106,571	146,904	206,593
Total	16,247,000	19,266,000	23,752,000	30,582,000	40,230,000

Table 7.7.2 Passenger Generation/Attraction Model Indicators 1 (urbanization degree)

Urbanization	2000	2005	2010	2015	2020
Damascus	12.620	11.612	10.724	9.995	9.298
Aleppo	2.921	2.678	2.475	2.316	2.172
Homs	3.052	2.848	2.660	2.506	2.344
Hama	0.876	0.818	0.768	0.727	0.685
Lattakia	4.172	3.835	3.543	3.306	3.079
Deir el-Zor	0.523	0.481	0.445	0.416	0.388
Idlib	0.897	0.832	0.777	0.733	0.689
Hassaka	0.818	0.756	0.701	0.656	0.610
Raqqa	0.823	0.775	0.730	0.692	0.650
As'sweida	1.478	1.372	1.275	1.192	1.107
Daraa	1.720	1.574	1.446	1.343	1.242
Tartous	1.537	1.424	1.324	1.243	1.160
Qunaitra	1.373	1.309	1.246	1.194	1.130

(2) Small Zone (Passenger and Freight)

The indicators used to distribute the generation and attraction volumes of freight by large zones are shown in Table 7.7.3.

Table 7.7.3 Distribution of Freight Attraction and Distribution Volumes on Small Zones

	Type	Generation volume	Attraction volume
0	Passengers	Urban area development	Urban area development
1	Crude oil	—	—
2	Petroleum products	Refinery location	Population distribution
3	Natural gas	—	—
4	Cement	Urban area development	Population distribution
5	Construction materials	Urban area development	Population distribution
6	Phosphate	Extraction facilities	Existing receiving shares
7	Iron	Production facilities	Existing receiving shares
8	Coal and cork	—	—
9	Other minerals	—	—
10	Wheat	Cultivated area distribution	Population distribution
11	Cereals	Cultivated area distribution	Population distribution
12.1	Vegetables	Cultivated area distribution	Population distribution
12.2	Fruits	Cultivated area distribution	Population distribution
13	Sugar beet	—	—
14	Rice	Present import origins	Population distribution
15	Cotton	Cultivated area distribution	Population distribution
16	Livestock	Cultivated area distribution	Population distribution
17	Animal products	Cultivated area distribution	Population distribution
18	Other agricultural products	Cultivated area distribution	Population distribution
19	Sugar	Production facilities	Population distribution
20	Food oil	Production facilities	Population distribution
21	Animal fodders	Cultivated area distribution	Cultivated area distribution
22	Beverages	Production facilities	Population distribution
23	Other food products	Urban area development	Population distribution
24	Chemical products	Production facilities	Urban area development
25	Metal products	Production facilities	Population distribution
26	Textiles and goods	Production facilities	Population distribution
27	Fertilizers	Production facilities	Cultivated area distribution
28	Paper products and pulp	Production facilities	Population distribution
30	Other manufactured goods	Urban area development	Population distribution
31	Mixed commodities	Present forwarding area and other city areas	Population distribution
32	Cork and wood	Present forwarding area	Urban area development

7.7.2 Future Trip Demand (Years 2000, 2005, 2010, 2015, and 2020)

(1) Passengers

The passenger indicators described in section 7.7.1 were applied to the model detailed in section 7.6 and the demand was forecast for the years 2000, 2005, 2010, 2015 and 2020. The demands for the years in between were estimated by interpolation. For the convenience of comparison the total OD pair traffic volumes were prepared for the year 2000 as well as

the railway OD traffic volumes with the master plan case for the years 2000, 2010 and 2020. Figures 7.7.1 and 7.7.2 show the railway passenger traffic demand in 2000 and 2020 respectively.

(2) Freight

On the basis of the present OD tables for each of the 32 study commodity types and the estimation formulas shown in Table 7.7.4, provisional figures for future transport demands were prepared. In a different way the estimated future GDP by industry sector (Table 7.7.5 shows the estimation formulas for the GDP and Table 7.7.6 the estimates) were used as control totals and after adjustment the future traffic demand volumes were fixed. Figures 7.7.3 and 7.7.4 show the railway freight demand in 2000 and 2020 respectively.

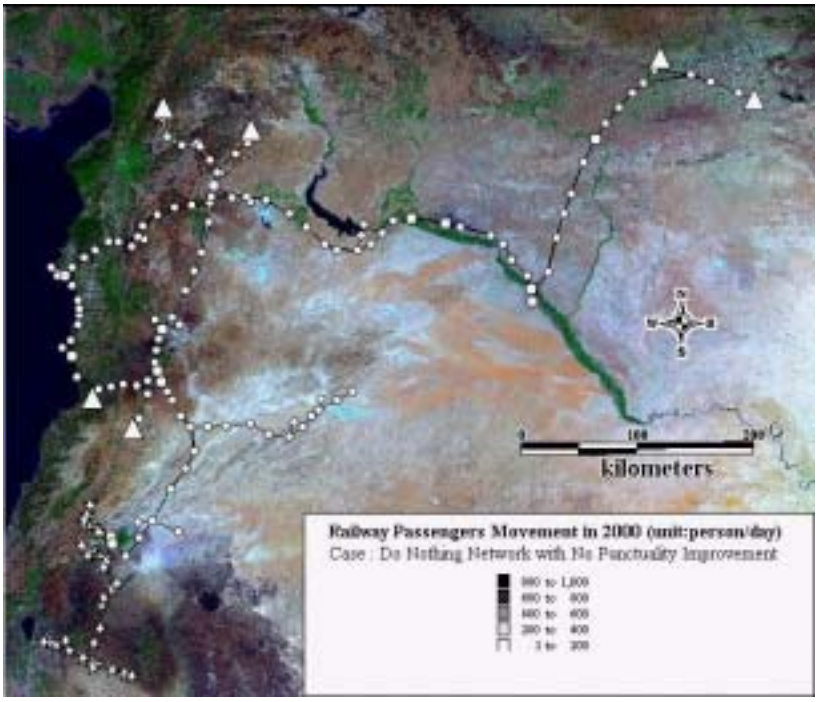


Figure 7.7.1 Passenger railway traffic assignment in 2000 (do nothing)

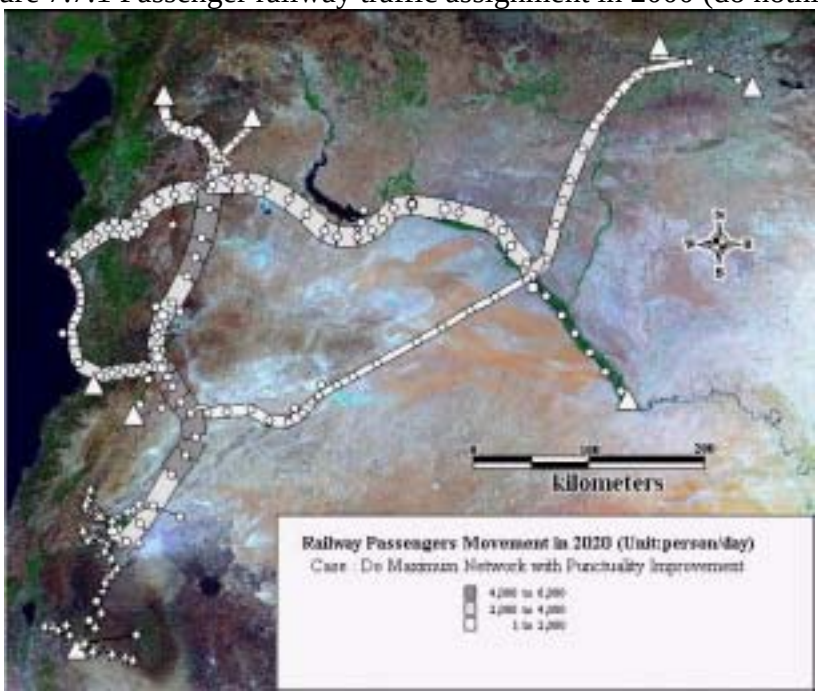


Figure 7.7.2 Passenger railway traffic assignment in 2020 (do maximum)

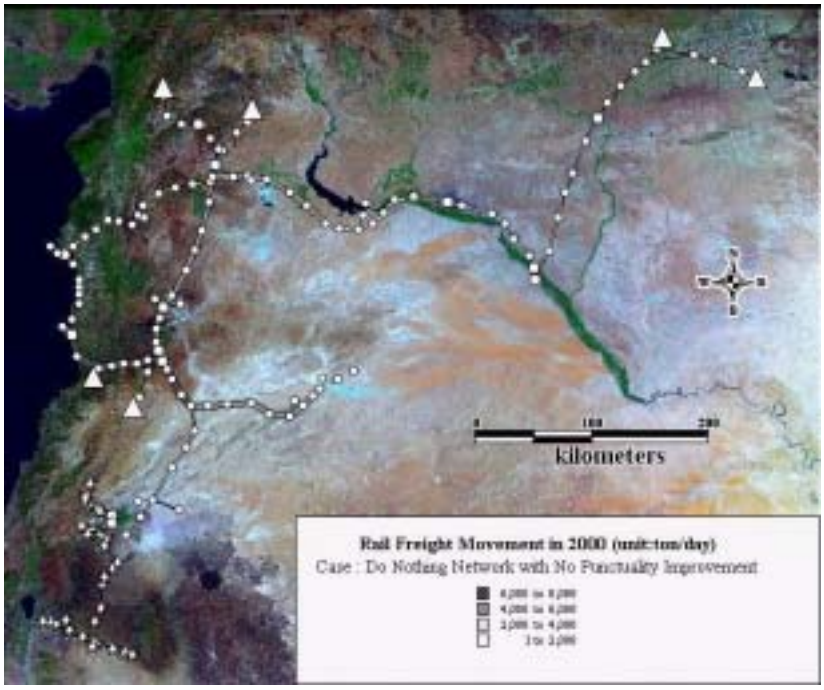


Figure 7.7.3 Freight railway traffic assignment in 2000 (Do nothing)

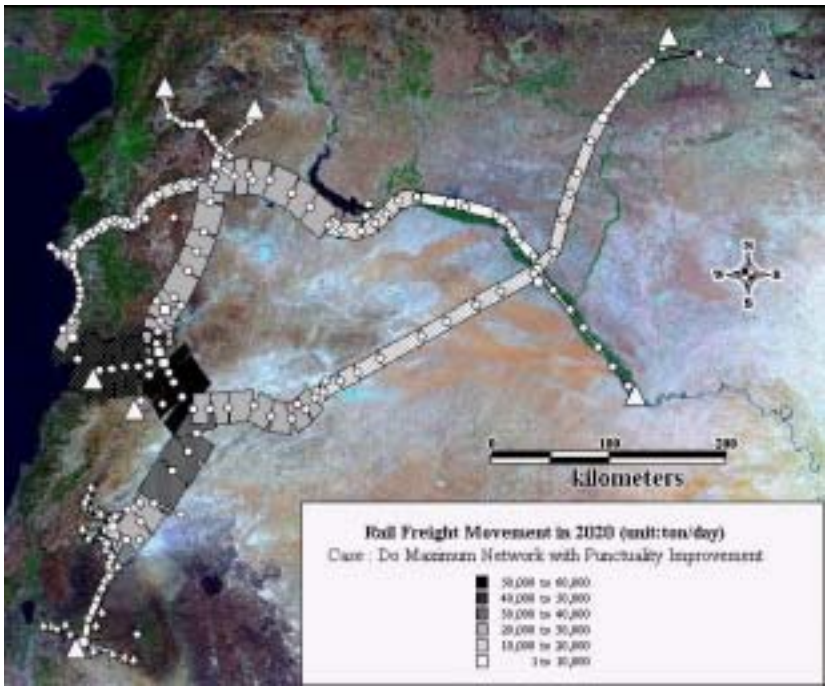


Figure 7.7.4 Freight railway traffic assignment in 2020 (do maximum)

Table 7.7.4 Estimation Formula by Commodity Type

Item	Independent Variable	Coefficient of I.V.	Constant	R^2
1-Crude oil	GDP/Cap	1105.97281	-14232252.64000	0.86
2-Petroleum products	GDP Manufacturing	21.56341	9780602.86800	0.99
3-Natural gas	Study Team Estimate		1.10000	Times
4-Cement	GDP Construction	140.66944	1030151.11700	0.72
5-Construction materials	Cement Production	6.86133	6975341.76400	0.48
6-Phosphate	Rate of Increase of Phosphate		1.01151	Times
7-Iron ore	Constant		1079.00000	
8-Coal and coke	Constant		130949.00000	
9-Other minerals	GDP Manufacturing	1.10386	166267.08190	0.45
10-Wheat	GDP Agriculture	37.96656	-2625627.59300	0.73
11-Cereals	GDP Agriculture	14.98662	-617625.57710	0.66
12-Vegetables	Rate of Increase of Vegetables		1.01714	Times
13-Fruit	GDP Agriculture	9.97260	504240.88990	0.73
14-Suger Beet	GDP/Cap	80.56825	-1994578.35600	0.58
15-Rice	Rate of Increase of Population		1.03225	Times
16-Cotton	Population	33.73627	-274417.02110	0.65
17-Livestock	Rate of Increase of Livestock		1.01561	Times
18-Animal Products	Rate of Increase of Animal Prod.		1.03837	Times
19-Agriculture Products	Rate of Increase of Agricultural products		1.03791	Times
20-Sugar	Sugar Beat		1.03861	Times
21-Food Oil	GDP Agriculture	1.01967	-35680.93071	0.66
22-Animal Fodders	GDP Agriculture	11.70600	-573317.95420	0.84
23-Beverages	GDP Total	0.35927	-120646.02700	0.78
24-Other Food Products	GDP Manufacturing	40.35405	-883867.19270	0.86
25-Chemical Products	GDP/Cap	4.95739	-94108.94823	0.66
26-Metal products	GDP Manufacturing	1.53094	-3844.22509	0.70
27-Textiles and clothes	GDP Manufacturing	2.64251	-58244.47873	0.87
28-Fertilizer	Rate of Increase of Fertilizer		1.00040	Times
29-Pulp for paper	GDP Manufacturing	0.95307	-52000.78785	0.85
30-Manufactured goods	GDP/Cap	4.72944	-123331.72110	0.89
31-Mixed commodities	GDP Manufacturing	0.29517	7356.07410	0.60
32-Cork and wood	GDP Manufacturing	1.45155	-75614.89127	0.76

Table 7.7.6 Coefficients for Estimation of GDP by Industrial Sector

Item/Year	Constant	Population	GDP	GDP/cap	R^2
Agriculture	-21,631.6	0	0.33572	0	0.95
Mining & Manufacturing	-172,426.0	18.21934	0	0	0.94
Building & Construction	-31,240.4	3.83558	0	0	0.96
Wholesale & Retail Trade	46,856.3	0	0.15372	0	0.70
Transport & Communication	-112,551.0	12.47000	0	0	0.95
Finance & Insurance	-22,082.5	0	0	1.19478	0.92
Social & Personal Service	-9,314.4	1.46963	0	0	0.89
Government Services	30,378.7	0	0	0.57889	0.67
Private Non Profit Services	-319.2	0.03718	0	0	0.97

Table 7.7.6 Forecast of Future GDP by Industrial Sector

(Unit: million SP)

Item/Year	2000	2005	2010	2015	2020
Agriculture	247,931	369,259	561,964	865,155	1,350,684
Mining & Manufacturing	127,022	188,901	284,011	432,038	650,758
Building & Construction	31,941	45,119	65,310	96,634	142,873
Wholesale & Retail Trade	171,867	229,122	319,249	459,889	684,372
Transport & Communication	92,554	135,070	200,349	301,838	451,747
Finance & Insurance	36,483	49,080	63,646	78,711	96,072
Social & Personal Service	14,968	20,097	27,921	40,008	57,825
Government Services	59,897	67,230	75,654	84,263	94,238
Private Non Profit Services	293	420	615	918	1,366
Total	782,956	1,104,297	1,598,721	2,359,453	3,529,935

Following are comments on each of the 32 commodity types. Production regions are considered on the governorate base.

Crude oil:

The remaining period for production years for crude oil is estimated at 12 years only (BP statistics, 1999). It is therefore unrealistic to consider increase of production and export quantities. In this study weight is placed on the domestic consumption and estimates are done using GDP/Capita. Exports are through Tartous seaport and refining shall continue at Homs and Tartous (Baniyas).

Petroleum products:

Main products are diesel oil, gasoline and light oil. Major users are in the industry sector and petroleum product well correlate with GDP. Production facilities are at Homs and Tartous (Baniyas). Refinery facilities in Homs are old. A rehabilitation plan, inclusive of relocation of the facilities has been prepared. Damascus and Aleppo together account for 51% of the total domestic consumption.

Natural gas:

Reserves are estimated as 8,500 billion cubic feet. In the absence of facilities at present the natural gas produced in the extraction of the oil is burnt. It is estimated that 6 million tons are burnt daily. CONOCO is presently constructing a facility to utilize the presently burnt natural gas, and this facility is expected to come into operation in July 2001. The planned increase in production after that is not clear. In this Study an annual increase of 10% is assumed.

Cement:

Estimates were done based on GDP of the construction sector. Producing governorates are in the order of highest production; Aleppo, Tartous and lastly Damascus (Adra). These three governorates (three plants) produce 89% of the total domestic production. During periods of high economic activities domestic production becomes insufficient and cement is imported from Jordan (via Daraa), Turkey (via Aleppo and Tartous), and Greece (via Tartous).

Construction materials:

Correlated to cement production quantities, however correlation is low.

Phosphate:

Homs is the only producing governorate. Of total production 74% is exported, mostly (94%) via Tartous seaport. Domestically used portion is processed into fertilizer at Homs. America and Morocco together account for 68% of total amount of phosphates produced globally. Although consumption amounts are stable they are not expected to grow significantly. In this Study the average growth in the last ten years was used to predict the future growth.

Primary iron products:

The past trend has remained almost fixed; 99% of total imports are coming into the country via Tartous seaport. Demand is concentrated in Hama (100%) where production facilities are located and recycling activities are also concentrated.

Coal and coke:

Production is at Homs and Tartous. Consumption is concentrated in the governorates of Hama, Damascus, Aleppo and Homs. Demand/supply balance is leaning in the favor of supply. Surplus is exported. Supply is basically delivered to industrial governorates. The trend in the past ten years has shown no growth and the present conditions are fixed.

Other minerals:

In the Study this commodity type is linked to the GDP of the industrial sector however correlation is low. Main items are salt (Aleppo) and natural asphalt (Hassaka, Deir el-Zor).

Wheat:

Wheat is an important agricultural crop in Syria. It is linked to GDP of the agricultural sector in the study. Produced in all governorates but highest in Hassaka.

Other Cereals:

Linked to GDP of the agricultural sector in the study. Beans are the most important. Produced in all governorates of the country.

Vegetables:

This commodity is both produced and consumed in each governorate. The production volumes have been predicted by extending the past trend.

Fruits:

Correlated to GDP of the agricultural sector. In principle a commodity type produced and consumed in each governorate however production in Lattakia is comparatively large. Main production fruits there are oranges and lemon.

Sugar beet:

Main production governorates are Hama, Aleppo and Idlib. Sugar producing facilities are also located in these governorates. When correlated with the GDP/capita in this study the correlation was very high.

Rice:

All demand is imported. Rice is consumed in all the country's governorates and is therefore linked to population figures.

Cotton:

Produced in all the governorates however largest quantity is in Hassaka (37%), followed by Raqqa, Aleppo and Hama. Export share of the total production is 63% and consequently the demand is concentrated to Lattakia (67%). Linkage with the population produced good correlation.

Livestock, animal products and agriculture products:

These products are all regionally produced and consumed products. Based on the past growth trends the future predictions were made. Taking into consideration the growth in population of 3.2%, with the exception of livestock the other products showed very similar growth rates to that.

Sugar:

Majority (84%) is imported. Imported amounts entering each of the seaports of Lattakia and Tartous are almost equal. Extending the past growth rates into the future the growth in this product almost coincided with the population growth.

Food oil:

Aleppo produces 39% of the total domestic production, followed by Tartous and Lattakia. These three regions account for 68% of the total production. The future production estimate has been correlated to the GDP of the agricultural sector. Demand is distributed all over the country.

Animal fodder:

Production is concentrated in Hama, followed by Hassaka, Aleppo and Raqqa. Demand is distributed all over the country. Both imports and exports of this commodity exist, but the balance leans in favor of imports. Imports account for 30% of the total supply amount. Correlated to GDP of the agricultural sector.

Beverages:

Damascus, Aleppo and Lattakia account for the majority (92%) of the national production. Demand is distributed all over the country. Future supply and demand is predicted based on correlation with GDP. In terms of quantity by weight the main item is mineral water.

Other food products:

Belong to agro-industry sector. The production amounts show high correlation with the industrial production distributed to all governorates.

Chemical products:

Majority of supply (80%) is imported. Consumption is distributed all over the country. Major item is detergent. Correlated to GDP/capita.

Metal products:

Majority of supply (88%) is imported. Consumption is distributed all over the country. There is good correlation with the GDP of the industrial sector. Relatively large-scale industrial plants are located at Hama (iron) and Lattakia (aluminum).

Textiles and clothes:

Both export and import amounts are large. Major exports are fabrics and clothes but textiles are major imports. On the one hand imports account for 88% of demand while exports represent 80% of production. Major production is in the large cities of Damascus, Aleppo and Lattakia and their surroundings. Demand follows a similar pattern. Correlated to GDP of the industrial sector.

Fertilizer:

Produced in Homs. While demand is observed all over the country it is obviously largest in the agricultural governorates of Hassaka and Aleppo. Predictions in this study made based on past trends but growth is only 0.04%.

Paper:

With the exception of 0.5% of total supply produced at Deir el-Zor all the paper is imported. Majority of imported amount enters the country via Lattakia. Demand is distributed throughout the country. Correlated to industrial sector GDP.

Manufactured goods:

The fact that the production and consumption is distributed throughout the country can be explained by the large-share of household appliances. Large-scale appliances are mostly imported. Although production is distributed throughout the country, the amount imported via Tartous seaport accounts for 60% of total supply. This is because analysis is on weight basis but if amounts are converted to monetary base most of the supply will be from imports. The reason why correlation with GDP/capita is high is because items such as passenger cars

are included in this commodity type.

Mixed commodities:

Production and consumption is on the local level. In terms of imports, Aleppo is the highest due to the large amount of small-scale electrical appliances included in this commodity type and their suitability to rail transport. Correlated to industry sector GDP.

Cork and wood:

Some part of the amount has been picked up from other parts. Imports account for 69% of the total supply. Domestically production is at Damascus and Aleppo. Correlated to industry sector GDP.

(3) Summation of Traffic Demand of the Master Plan Case

Under the master plan the number of passengers and amount of freight transported by rail in the year 2020 are expected to increase by 6.3 times and 6.8 times the present figures for each respectively. The shares of rail transport of the total land based transport in 2020 are predicted to be 5% for passengers and 9% for freight (see Table 7.7.7).

In terms of link traffic volumes the largest rail freight transport in 2020 is forecast along the Mhine – Homs link at 51,300 tons daily followed by 44,900 tons daily between Tartous and Homs. Aleppo – Lattakia rail link will transport the largest amount of passengers in 2020, at 5,900 persons per day.

Table 7.7.7 Summation of Traffic Demand Forecast excluding Intra-zonal Volume (M/P case)

Indicators	1999	2005	2010	2015	2020
GESR					
Passenger/day	2,323	4,182	6,186	9,860	14,546
Passenger-km/day	512,329	1,511,601	2,522,666	3,934,874	5,664,719
Ton/day	14,918	22,494	35,291	62,409	103,118
Ton-km/day	4,320,548	6,991,714	11,904,130	21,300,641	35,944,313
Road					
Passenger/day	129,973	138,985	189,029	211,867	303,546
Passenger-km/day	34,111,692	38,318,171	46,257,908	58,489,459	76,211,042
Ton/day	215,612	259,379	554,240	587,486	1,066,510
Ton-km/day	51,509,893	73,191,522	107,202,860	162,601,950	245,610,890

Chapter 8

Transportation Plan

Chapter 8 Transportation plan

8.1 Concept on transportation plan

To secure safety is essential item for all transport industries. At the same time, improvement of efficiency is required, as well.

On setting up total plan of rehabilitation and modernization of GESR, the railways should be well improved so as to cope with users' requirement and to fully display the role of railway, bearing in mind the above mentioned policy of securing safety and improvement of efficiency.

8.2 Fundamental premises for setting up transportation plan

Transportation plan is set up as follows based on above mentioned concept.

8.2.1 Targeted lines and operating speed.

(1) Targeted lines and operating speed

Set up plan is for almost all existing lines in GESR and proposed new lines. The operating maximum speed by line is as in Table 8.1.

Table 8.1 Section of respective line and maximum speed

	Line Name	Section	Distance (km)	Maximum Speed		Remarks
				Passenger Train	Freight Train	
1	Jubrin- Midan Ekbas	Jubrin – Midan Ekbas	133.2	130	100	
2	Jubrin- Damasucus	Jubrin – Damascus	401.9	130	100	
3	Muslimiyya-Arrai	Muslimiyya-Arrai	85.9	130	100	
4	Jubrin –Lattakia- Homs 1	Jubrin –Lattakia	204.9	130	100	
		Lattakia- Tartous	85.9	130	100	
		Tartous- Homs 1	95.3	130	100	
5	Jubrin- Qamishli-Al Yaroubiye	Jubrin- Deir el-Zor (passenger)	323.0	130	100	
		Deir el Zor-New Qamishili	198.6	130	100	
		New Qamishli -Al Yaroubiye	79.5	130	100	
6	Mhine- Al Sharqia	Mhine- Al Sharqia	110.7	130	100	
7	New Line	Al-Sharqia-Deirl-Zor(passenger)	238.5	130	100	
		Deir el Zor-Al Bukamal	140.1	130	100	
		Damascus(Freight) - Darra	97.5	130	100	
Total			2,195.0			

However, the permissible speed of locomotive hauled passenger train is 100km/h.

(2) Maximum Train Speed

1) In railway passenger transport, how to increase the schedule speed of trains is more important than how to raise the maximum speed. The “scheduled speed” means the average speed between the departure station and the destination station including the stooping times at intermediate stations. In the Master Plan, train operation at the following speeds is aimed at.

Maximum speed of passenger trains = 130 km/h(diesel-car trains)
Maximum Speed of sleeper-car trains = 100 km/h(diesel locomotive-hauled)
Schedule speed of passenger trains =about 100km/h
Maximum speed of freight trains = 100km/h
Schedule speed of freight trains=about 60km/h

2) As for the present situation of GESR, the following problems have been observed.
   (a) There are many level crossings with roads. The protection facilities, track structure, and maintenance of these crossings are insufficient, causing the slow operation of train there.
   (b) There are many illegal and dangerous level crossings, where tractors, residents, and livestock often cross the tracks.
   (c) Maintenance of turnouts is insufficient, causing slow operation of trains even on the straight side of the turnouts.
   (d) Track irregularities are large.
   (e) Deterioration of facilities and so forth (locomotive trouble, track failure, signal trouble, etc.) are causing chronic delay of trains.
   (f) There are many accidents due to errors of railway employees, requiring for the promotion of further effective personnel training.

At first, by sufficiently solving the above problems to carry out safe and punctual train operation without the need for speed reduction, the present scheduled speed of trains can be increased by 50 to 70% even if the maximum of passenger trains is about 130km/h. (For example, on the section between Damascus and Aleppo which requires 5 hours and 55 minutes to cover at present, actual transport time is 7 hours or more, because trains always delay by 1 hour to 2. By the improvement under the Master Plan, the transport time on the section will become 4 hours, and the schedule speed will be 7/4= 1.7 times the present value. Furthermore, on the section between Aleepo and Lattakia which

requires 2 hours and 41 minutes to cover at present, actual transport time is 2 hours and 80 minutes (3.33 hours), because trains always delay by about 40 minutes. By the improvement under the Master Plan, the transport time on the section will become 2 hours and 15 minutes (2.25 hours), and schedule speed will be 3.33/2.25= 1.5 times the present value.

3) The Master Plan has proposed the above improvement. As for the new lines, the design maximum speed is set at 160 km/h for passenger trains and 120 km/h for freight trains. The maximum speed is not so important for sleeper-car trains, and an essential condition for them is to depart and arrive in adequate time zones. The time zones which are set for sleeper-car trains by GESR at present are considered almost adequate. As for freight trains, it is important to make possible to exactly forecast their arrival times.

4) The Master Plan has proposed the execution of improvement measures against all problems described in the item 2) above. For this purpose, a large amount of cost (SP 113.8 billion: total amount of investment under the Master Plan, excluding the new line construction cost of SP 46.3 billion) will be necessary. In view of the average speed of buses, the railway will be able to sufficiently compete with buses, if the maximum speed and schedule speed of passenger trains are 130 km/h and 100 km/h, respectively.

5) For increasing train speed further (for example, to increase the maximum speed to 160 km/h), the cost for the grade separation of many level crossings will be necessary from the standpoint of ensuring transport safety, in addition to the amount of investment under the Master Plan. As a matter of course, there are various other objects of additional investment, such as the purchase of high-speed rolling stock; improvement of signaling systems; installment of obstruction detection and warning devices; re-installing of cant and extension of transition curves at curves with large radius; correction of track irregularities; and introduction of turnout for high-speed operation.

6) Sometime in the period up to 2020 hereafter, reviewing of the Master Plan itself will become necessary according to the economic development of Syria; changes in the relations of Syria with other countries; and changes in other background conditions of the plan. Concerning this matter, the following are recommended.

① For the time being, promote the present Master Plan in which the maximum speed

of passenger trains is set at 130 km/h.

② After about 10 years, review the master Plan on the basis of the changes in socioeconomic situations; progress of the Master Plan; actual situation of improvement in GESR; and other related factors.

At the above reviewing of the Master Plan, conduct study on whether further increase in the maximum speed beyond 130 km/h should be aimed at or not.

7) Special Appendix presents discussion on technical requirement for realization of 160km/h passenger train operation between Aleppo and Damascus.

8.2.2 Signaling system

Signaling system which is a fundamental condition of train operation, should be an automatic blocking system.

On single track section, install track circuit fully in the station and on the track between stations, install the detecting track on both ends of station to detect arriving and departing of train for securing blocking between stations.

The multi-color right signal currently used is to be applied for home and departure signal, and home signal is to be with distant signal for single track section.

Traffic side of train operation is to be on the right side traffic.

8.2.3 Driving power system

As for powering system, diesel engine is adopted, but electrification which requires big investment will not be adopted. Overnight sleeper train is to be hauled by diesel electric locomotive (DEL). Day time operating train is to be by diesel railcar (DC) train which makes possible small formation and frequent service.

Regarding day time train, DEL traction passenger coach train and Diesel car trains are to be co-used by 2010, but after 2010, all day time passenger trains are by small formation of diesel railcar (DC) train to perform frequent service.

8.2.4 Kind of train and formation

(1) Kind of train

Kind of train is passenger train and freight train, and passenger train is consisted of express train and local train. Night sleeper express train is to be programmed on the trunk lines.

Freight train is planned only as a kind of through train without stopping between principal stations.

(2) Train formation

a. Passenger train

Referring to the result of forecasted transportation demand, the formation of sleeper train is 9～11 coaches and daytime passenger coach train is 2～4 coaches and that of DC train is 1～5 cars considering frequent service.

The formation of sleeper train is consisted of sleeping coach, 1st class seating coach, dining car and baggage car.

・ Night sleeping car train

Sleeper Train

1	2	3	4	5	6	7	8	9	10	11
Baggage Car	Sleeping car	Sleeping car	Sleeping car	Sleeping car	Sleeping car	Dining car	1st class seating car	1st class seating car	1st class seating car	1st class seating car

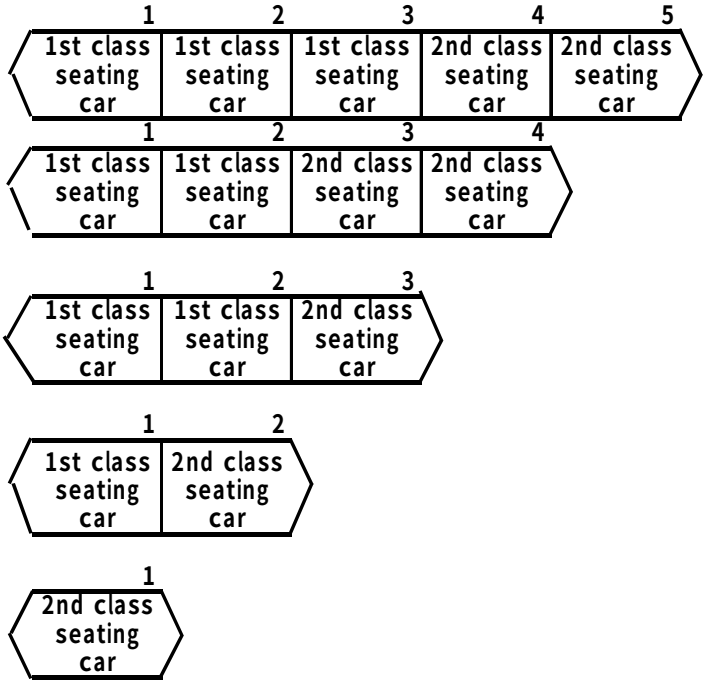
1	2	3	4	5	6	7	8	9
Baggage Car	Sleeping car	Sleeping car	Sleeping car	Sleeping car	Dining car	1st class seating car	1st class seating car	1st class seating car

・ Daytime passenger train

1	2	3	4
1st class seating car	1st class seating car	2nd class seating car	2nd class seating car

1	2
1st class seating car	2nd class seating car

・ Diesel railcar train



Note; ;With Driver Cabin Car

b. Freight train

The single headed operation is the principle of freight train and hauling capacity is to be 1400 ～ 2000 tons with 70% of hauling efficiency and 60% of loading factor, referring to the current actual performance.

In addition to above, if the hauling capacity become half due to steep gradient, double headed operation is planned.

(3) Train operation

a. In case of passenger train, usually two men crew, driver and conductor, is planned on a train except sleeping train. In case of sleeping train, servicing staff is to be assigned other than two men crew.
b. On freight train, only driver is assigned but no conductor.

8.2.5 Rolling stock and its characteristics

The aged rolling stock are to be phased out. The ordinary passenger train excluding night sleeper train and international train is formed by only DC with possible maximum speed of 130km/h to increase operating efficiency.

In case of locomotives, high output locomotives will be assumed smaller output locomotives on the condition that track will be renovated so as to accommodate the high output locomotive.

8.2.6 Transportation demand

Result of transportation demand study is as follows. Cross sectional traffic volume is in the Appendix 8.1 and Appendix 8.2.

Year	1999	2005	2010	2015	2020
Passenger/day	2,323	4,182	6,186	9,860	14,546
Passneger-km/day	512,329	1,511,601	2,522,666	3,934,674	5,664,719
Ton/day	14,918	22,494	35,291	62,409	103,118
Ton-km/day	4,320,548	6,991,714	11,904,130	21,300,641	35,944,313

8.2.7 Riding factor and hauling factor

(1) Riding factor

The riding factor of passenger train is premised as 70%. Formation of ordinary train does not include dining car nor baggage car but consists of seating car.

Seating capacity of 1st class coach is 60 and 2nd class, 80, while the capacity of sleeping car is 22.

(2) Hauling factor

Based on the actual result, hauling factor of freight car is to be 70% and 60% of hauling capacity is loading weight

(3) Fluctuation of transportation

Based on the actual result, seasonal fluctuation of passenger train is to be 30% in section between Aleppo～Lattakia and 10% in other sections, and for freight train,10%

(4) Turn round of freight wagon

Expecting the following items; shortage of time for loading and unloading, increase of train speed, establishment of freight wagon relay system, and increased availability of wagon by strengthened information system; and considering transport distance, turn

round of wagon is to be 6 days and exclusive wagon for phosphate, 1.3 days.

(5) Empty wagon rate

Rate of empty wagon is to be 40%.

8.3 Transportation plan

(1) Train operation plan

1) Calculation of train operation time

Besides above mentioned premises, and taking into account line condition such as curvature, gradient, location of turnouts and performance of diesel car and diesel locomotive, the train running curve is drawn to decide theoretical train operation time, then margin is added to obtain practical train operation time.

- Operating speed limit of turn out is assumed as 40km/h for branch track side and 100km/h for straight track side

  The location of turnout is assumed to be at 500m from center of station in the Study although actual location of turn out is unknown.
- Speed restriction on curved track is as stipulated by GESR.
- Speed restriction on down gradient is set based on stipulation of Japanese Railways (115km/h on 20‰ down gradient)
- As for diesel railcar, Japanese railcar for limited express (model 181, 3960PS, 319tons, formed with 7 coaches) is applied. As for locomotive, performance of locomotive with 2800PS working in GESR was applied to calculate the hauling capacity on respective line.
- For proposed new line, train operation time is so planned as to obtain the schedule speed of about 100km/h for passenger train and about 80 km/h for freight train although line condition of track is not clear. Furthermore, considering feeder transport facilities at terminals, departure time of overnight sleeper train is to be before 23 o'clock and arriving time, after 5 o'clock.

Table 8.2 and Table 8.3 indicate planned passenger or freight train operation time on respective lines

Table 8.2 Operating time for Passenger train

Section		Schedule Time (h:m)	Distance (km)	Schedule Speed (km/h)	Stooping Time(m)	Stopping Station	Present schedule Time(h:m)
Aleppo～Damascus(Hijaz)	Sleeping	8:00	399.8	49.9			5:55
	Express	4:00	399.8	99.9	2	Homs, Hama	
	Local	6:35	399.8	60.7	53		
Aleppo～Qamishli	Sleeping	9:00	530.9	58.9			7:29
	Express	5:15	530.9	101.1	6	Rakka,Deir el Zor,Hassaka	
	Local	7:15	530.9	73.2	50		
Aleppo～Lattakia	Express	2:15	205.0	91.1	0	Non	2:41
	Local	3:20	205.0	61.5	25		
Damascus(Hijaji)～Lattakia	Sleeping	8:00	391.7	48.9			5:40
	Express	4:15	391.7	92.2	4	Homs Tartous	
	Local	6:20	391.7	61.8	50		
Aleppo～Midan Ekbas	Local	1:45	116.6	66.6	10		2:48
Musli,ia～Arrai	Local	0:45	45.2	60.2	4		
Damascus(Hijaji)～Darra	Express	1:00	96.9	96.9	4		
	Local	1:30	96.9	65	12		
Mhine～Sharqia～Deir el Zor	Express	3:50	360	93.9	6	Sharqia Tadomor Deir el Zor(w)	
Deir el Zor～Bukamal	Local	2:15	140	62.2	10		
Qamishili～Yaroubiye	Local	0:55	79.4	86.6	4		

Table 8.3 Operating time for freight train

Section	Schedule Time (h:m)	Distance (km)	Schedule Speed (km/h)	Stopping Station	Present schedule Time(h:m)
Ansari～Homs	2:50	188.3	66.5	Hama,Sinjar	3:29
Homs～Damascus	3:10	194.1	61.3	Noamia	3:27
Homs～Lattakia	3:10	184.7	61.6	Tartous	3:41
Mhine～Sharqia	1:40	110.7	66.4		1:54
Sharqia～Del el Zor(F)	3:10	254.8	80.5	Tadomor	
Jublin～Deri el Zor	4:00	316.5	79.1	Raqqa	5:15
Deir el Zor～Qamishili～Al yaroubiye	4:15	287.2	67.6	Hassake,Qamishili	5:34
Ansari～Lattakia	3:30	189.1	54.0	Muhanbel	4:31
Damascus～Darra	1:15	97.5	78.0		
Deir el Zor～Al Bukamal	1:45	140.1	80.0		

2) Planning of transportation

Transportation capacity is planned based on cross sectional transportation volume, OD table and pre-mentioned train operation plan.

a) Passenger train operation plan

Passenger train is planned as in Table 8.4 and Fig.8.1 with frequent operation as far as possible to obtain improved service.

Table 8.4 Passenger train operation plan by section

Year		2005				2010				2015				2020			
Section	Train Type	DC		PC	Total	DC		PC	Total	DC		PC	Total	DC		PC	Total
	Class	1st	2nd			1st	2nd			1st	2nd			1st	2nd		
Aleppo ～ Damascus	No. of car/Train	2	2	9		2	2	9・4		3	2	11		3	2	11	
	Aleppo-Hama	4		4	8	6		2	8	12		2	14	16		2	18
	Hama-Homs	4		4	8	8		2	10	14		2	16	16		2	18
	Homs-Mhine	6		6	12	8		4	12	18		4	22	22		4	26
	Mhine-Damascus	6		6	12	10		8	18	18		6	24	22		6	28
Aleppo～ Midan Ekbas・Arri	No. of car/Train		1	2		1	1	2	3	1	1			1	2		
	Aleppo-Muslimia	2		4	6	4		2	6	6			6	6			6
	Muslimia-Midan Ekbas	2		4	6	4		2	6	6			6	6			6
	Muslimia-Arrai	2			2	2			2	2			2	2			2
Mhine～ Deir el Zor	No. of car/Train							9・4		3	2	11		3	2	11	
	Mhine-Tdmor	0			0			4	4	4		2	6	4		2	6
	Tadmor-Deir el Zor	0			0			4	4	4		2	6	4		2	6
Homs～ Lattakia	No. of car/Train	1	1	9・4		2	2	9・4		2	2	11		3	2	11	
	Homs-Tartous	4		4	8	4		4	8	8		2	10	10		2	12
	Tartous-Lattakia	4		4	8	4		4	8	8		2	10	8		2	10
Aleppo～ Lattakia	No. of car/Train	2	2	4		3	2	5		3	2			4	4		
	Aleppo-Jisr Elshogour	10		2	12	10		2	12	18			18	20			20
	Jisr Elshogour-Lattakia	10		2	12	10		2	12	18			18	20			20
Aleppo～ Deir el Zor	No. of car/Train	2	2	9・4		2	2	9・4		2	2	11		2	2	11	
	Aleppo-Raqqa	2		6	8	4		4	8	8		2	10	18		2	20
	Raqqa-Deir el Zor	2		6	8	4		4	8	8		2	10	16		2	18
Deir el Zor ～Qamishili	No. of car/Train	1	1	9		2	2	9・4		2	2	11		2	2	11	
	Deir el Zor-Hassaka	2		8	10	4		6	10	6		4	10	10		4	14
	Hassaka-Qamishili	2		8	10	4		6	10	6		4	10	10		4	14
No. of car/Train				2				2			1			1	1		
Qamishili-Al-Yaroubiye				4	4			4	4	4			4	4			4
No. of car/Train											1			1	1		
Damascus ～Darra										6			6	6			6
No. of car/Train				2				2			1				1		
Deir el Zor～Al Bukamal				2	2			2	2	2			2	2			2

① Aleppo～Damascus

○ The formation of sleeper train is tow couple of trains (go and return) consisting of 9 cars (in 2020, 11 cars) including 1st class seating car, dining car and baggage car.

One of them is from Qamishili via Apello and one of them is from Aleppo

One train, Qamishili～Damascus via Aleppo, is planned to change the train route to Qamishili～Tadmor～Al-Shrqia～Mhine, making use of new line between Deir el Zor ～Tadmor on and after 2010.

Homs～Damascus is one couple of trains (go and return) with 9 cars starting from Lattakia.

○Yearly day time train (go and return) is as follows.

・2005 Aleppo～Damascus, 2 couple of through train with 4 coaches

formation

・2010 Aleppo～Damascus, 3 couple of through train with 4 coaches formation

Hama～Homs, one couple of local train with 4 coaches

Homs～Damascus, one couple of train from Lattakia with 4 coaches formation

Mhine～Damascus, one couple of train from Qamishili with 4 coaches formation (hauling by DEL)

・2015 Aleppo～Damascus, 6 couple of through trains with 5 coaches formation

Hama～Homs, one couple of local train with 5 coaches

Homs～Damascus, tow couple of train from Lattakia with 5 coaches formation

Homs～Mhine, one couple of train for Qamishili with 5 coaches formation

Mhine～Damascus, one couple of train from Qamishili with 5 DC coaches formation

・2020 Aleppo～Damascus, 8 couple of through trains with 5 coaches formation

Homs～Damascus, tow couple of train from Lattakia with 5 coaches formation

Homs～Mhine, one couple of train for Qamishili with 5 coaches formation

Mhine～Damascus, one couple of train from Qmamishili with 5 coaches formation

②Aleppo～Mida Ekbas・Arrai

・2005 Aleppo～Midan Ekbas, one couple of trains with one DC coach formation and tow couple of trains with tow PC coach formation

Muslima～Arrai, one couple of train with one DC coach formation

・2010 Aleppo～Midan Ekbas, one couple of trains with one DC coach

formation and tow couple of trains with tow PC coach formation
Muslima～Arrai, one couple of train with one DC coach formation

- 2015 Aleppo～Midan Ekbas, 3 couple of trains with 2 coaches formation
  Muslima～Arrai, one couple of train with 2 coaches formation
- 2020 Aleppo～Midan Ekbas, 3 couple of trains with 3 coaches formation
  Muslima～Arrai, one couple of train with 3 coaches formation

③Mhine～Al sharqia～Tadomr～Deir el Zor

- 2010 one couple of trains with 4 PC coaches formation for directly operate to Damascus
- 2015 two couple of trains with 5 DC coaches formation but one couple of train directly operate to Damascus and other train directly operate to Homs
- 2020 two couple of trains with 5 DC coaches formation but one couple of train directly operate to Damascus and other train directly operate to Homs

④Homs～Lattakia

○ Sleeper train is to be operated until Damascus as it is, the formation is 9 coaches at beginning, 11 coaches on and after 2010

○ Daytime train is ;

- 2005 one couple of trains with 4 PC coaches formation and 2 couple of trains with 4 DC coaches formation, one couple of DC train directly operate to Damscus
- 2010 one couple of trains with 4 PC coaches formation and 2 couple of trains with 4 DC coaches formation, one couple of DC train directly operate to Damscus
- 2015 4 couple of trains with 4 coaches formation, tow couple of train directly operate to Damscus
- 2020 5 couple of trains with 5 coaches formation, 3 couple of train directly operate to Damscus

⑤Aleppo～Lattakia

- 2005　5 couple of trains with 4 DC coaches formation and one couple of trains with 4 PC coaches formation
- 2010　5 couple of trains with 4 DC coaches formation and one couple of trains with 4 PC coaches formation
- 2015　9 couple of trains with 5 coaches formation
- 2020　10 couple of trains with 5 coaches formation

⑥Aleppo～Deir el Zor

○ Sleeper train Aleppo～Qamishili two couple of train with 9 coaches formation(11 coaches formation on after 2015),one couple of them is to be operated to Damascus, on after 2010, one couple train is planned to change the train route detouring Qamishili ～Tadomor ～ Mhine～Damascus without dropping at Aleppo.

○ Day time train

- 2005　Aleppo～Deir el Zor one couple of trains with 4 PC coaches formation and one couple of trains with 4 DC coaches formation
- 2010　Aleppo～Deir el Zor one couple of trains with 4 PC coaches formation and two couple of trains with 4 DC coaches formation
- 2015　Aleppo～Deir el Zor 4 couple of through trains with 4 coaches formation
- 2020　Aleppo～Deir el Zor 8 couple of through trains with 4 coaches formation

  Aleppo～Raqqa one couple of train with 4 coaches

⑦Deir el Zor ～Qamishili

○ Sleeper train from Aleppo and Damasucus two one couple of train

○ Day time train

- 2005　2 couple of trains with 2 PC coaches formation and one couple of trains with 2 DC coaches formation

- 2010 one couple of trains with 2 PC coaches formation, and 2 couple of trains with 4 DC coaches formation, one couple is through train for Aleppo and one couple is through train for Damascus via Tadomor.
- 2015 3 couple of trains with 4coaches formation, two couples are through train for Aleppo and one couple is through train for Damascus via Tadomor
- 2020 5 couple of trains with 4 coaches formation, two couples are through train for Aleppo and two couples are through train for Damascus and Homs via Tadomor

⑧Qamishili～Al Yaroubiye

2 couple of local train with one coach formation

⑨Mhine～Tadmor～Deir el Zor

○ Sleeper train one couple of train with 9 coaches formation(11 coaches formation on after 2015) is to be operated to Damascus.

○ Day time train

- 2010 one couple of PC coach train with 4 coaches formation is through train for Damascus
- 2015 2 couple of trains with 5 coaches formation, one couple is through train for Damascus and one couple is through train for Homs
- 2020 2 couple of trains with 5 coaches formation, one couple is through train for Damascus and one couple is through train for Homs

⑩Damascus～Darra

3 couple of local trains with one coach formation

⑪Deir el Zor～Al Bukamal

1 couple of local train with one coach formation

Fig. 8.1 indicates line-wise operating system of passenger train.

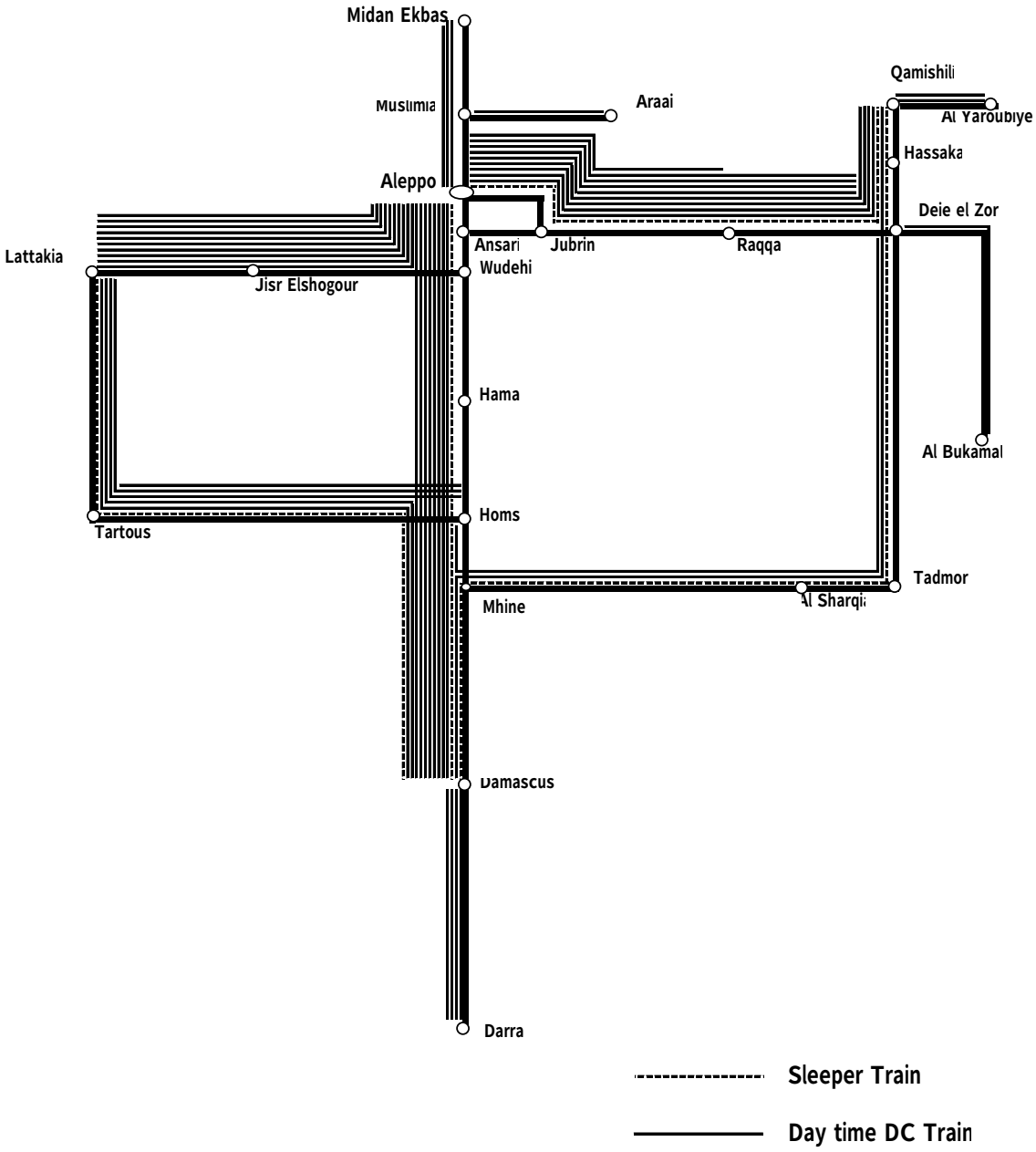


Fig. 8.1 Line wise operation plan of Passenger train

b) Freight train operation plan

Set up the freight transportation plan to cope with transportation demand.

Yearly and sectional train operation plan is as indicated in Table 8.5.

Table 8.5 Yearly and sectional freight train operation plan

Year			Hauling	2005			2010			2015			2020		
Section			Capacity	Phosphate	Other	Total	Phosphate	Other	Total	Phosphate	Other	Total	Phosphate	Other	Total
Jubrin-Damascus	Jubrin-Aleppo		1400		2	2		4	4		8	8		16	16
	Jubrin-Ansari		1400		12	12		12	12		32	32		58	58
	Aleppo-Ansari		1400		4	4		10	10		18	18		32	32
	Ansari-Wudehi		1400		18	18		24	24		50	50		90	90
	Wudehi-Abu Dhour		1400		14	14		16	16		36	36		64	64
	Abu Dhour-Sinjar		1400		12	12		16	16		32	32		56	56
	Sinjar-Hama		1400		12	12		14	14		30	30		52	52
	Hama-Homs		1400		14	14		18	18		36	36		62	62
	Homs-Mhine		1400	14	16	30	18	36	54	22	65	87	26	110	136
	Mhine-Khanat		1400		16	16		30	30		56	56		94	94
	Khanat-Dmeir		1400		18	18		30	30		58	58		98	98
	Dmeir-Damascus(f)		1400		6	6		8	8		10	10		12	12
Dmeir-Kaboun	Dmeir-Adra		1400		8	8		8	8		34	34		60	60
	Adra-Kaboun		1400		8	8		8	8		34	34		60	60
Aleppo-Midan Ekbas-Arrai	Aleppo-Muslimia		1400		10	10		10	10		22	22		38	38
	Muslimia-Qatma		1400		2	2		4	4		10	10		14	14
	Qatma-Midan Ekbas	W	1250		2	2		6	6		10	10		18	18
	Muslimia-Arrai	W	1250		2	2		4	4		8	8		14	14
Mhine-Tadmor-Deir el Zor	Mhine-Al Fajiwa		1400	14	2	16	18	12	30	22	20	42	26	36	62
	Al Fajiwa-Al Sharqia		1400	12	2	14	14	12	26	18	20	38	22	36	58
	Al Sharqia-Tadmor		1400		2	2		12	12		22	22		38	38
	Tadmor-Deir el Zor(f)		1400		0	0		12	12		20	20		36	36
Homs-Lattakia	Homs-Tartous	W	1400	14	26	40	18	46	64	22	68	90	24	102	126
	Tartous-Sharbit		1400		4	4		4	4		8	8		14	14
	Sharbit-Lattakia (p)		1400		4	4		4	4		8	8		14	14
Wudehi-Lattakia	Wudehi-Bishmaroun		2000		4	4		6	6		10	10		18	18
	Bishmaroun-Mhambel		2000		4	4		6	6		12	12		20	20
	Mhambel-Frika		1400		6	6		8	8		16	16		28	28
	Frika-Sheikhana		1400		6	6		8	8		16	16		26	26
	Sheikhana-Arkabir		1400		6	6		6	6		12	12		20	20
Jubrin-Deir el Zor-Yaroiblye	Jubrin -Tel Blat		2000		8	8		8	8		14	14		28	28
	Tel Blat-Sheikh Ahmad		2000		8	8		8	8		14	14		26	26
	Sheikh Ahmad - Qadissiya		2000		8	8		8	8		14	14		26	26
	Qadissiya-Al Grin		2000		8	8		8	8		14	14		26	26
	Al grin-Raqqa		2000		6	6		6	6		12	12		24	24
	Raqqa-Deir el Zor(f)		2000		6	6		4	4		8	8		16	16
	Deir el Zor(f)-Hassaka		2000		4	4		8	8		12	12		22	22
	Hassaka-New Qamishli		2000		2	2		4	4		6	6		10	10
	New Qamishli-Qahtaniyya		2000		2	2		4	4		6	6		2	2
	Qahtaniyya-Tel Alo		2000		2	2		2	2		2	2		2	2
	Tel Alo-Al Yaroublye		2000		0	0		0	0		2	2		2	2
Damascus(f)-Daraa	Damascus-Alkesweh		1400		0	0		1	1		34	34		58	58
	Alkesweh-Sanamein		1400		0	0		0	0		16	16		28	28
	Sanamein-Daraa		1400		0	0		0	0		14	14		24	24
Deir el Zor-Bukamal	Deir el Zor-Tabiye		1400		6	6		6	6		8	8		10	10
	Tabiye-Mayadin		1400		2	2		4	4		6	6		10	10
	Mayadin-Al Bukamal		1400		2	2		2	2		4	4		6	6

Note: "W" is assisting run of a locomotive

The train exclusively transporting phosphate rock is planned to operate on the section of Tartous～Homs～Mhine～Al-Sharqia, and other freight train is planned as general freight transporting train.

After completion of new line between Deir el Zor～Al Sharqia in 2010, goods flow

between Deir el Zor～Jubrin～Lattakia is to be shifted to Deir el Zor～Al Sharqia～Mhine～Homs～Tartous.

3) Train kilometer and car kilometer

Table 8.6 indicates daily train kilometer and car kilometer calculated by yearly transportation plan.

Table 8.6 Train kilometer and car kilometer

Year		1999	2005	2010	2015	2020
Passenger/day		2,323	4,182	6,186	9,860	14,546
Passneger-km/day		512,329	1,511,601	2,522,666	3,934,674	5,664,719
Ton/day		14,918	22,494	35,291	62,409	103,118
Ton-km/day		4,320,548	6,991,714	11,904,130	21,300,641	35,944,313
Train km /Day	Passenger Train	2,931.5	14,223.2	16,340.4	22,790.8	28,866.6
	Freight Train	11,453.4	18,448.3	30,853.9	53,039.6	86,478.1
	Total	14,384.9	32,671.5	47,194.3	75,830.4	115,344.7
DC	Train Km/day	0.0	6,151.8	8,446.0	18,712.2	24,788.0
	Car km/day	0.0	21,318.2	34,563.6	80,034.2	120,717.6
PC	Train km/day	2,931.5	8,071.4	7,894.4	4,078.6	4,078.6
	Car km/day	18,141.9	50,989.2	50,036.4	41,781.0	41,781.0
FC	Car km/day	174,268.6	280,414.9	468,979.3	806,201.9	1,314,467.1
LOC Car km/day	For Passenger train		8,878.5	8,683.8	4,486.5	4,486.5
	For freight train		21,096.7	35,426.4	60,908.1	99,803.4
	Total	14,767.1	29,975.2	44,110.2	65,394.6	104,289.9

(2) Operation safety securing system

Blocking system: Automatic blocking system

Signaling system: Multi-color light system

Interlocking system: Electronic interlock system

To secure safety of train operation, ATS (Automatic Train Stop) is provided in principle.

1) Blocking system

All lines should be provided with automatic signaling system to secure safety of train operation.

On double track section, automatic blocking system with track circuit even both in stations and in sections between stations is to be provided

On single track section, automatic blocking system without track circuit on track between stations is to be employed, but inside of station, all tracks is provided with continuous track circuit. Furthermore, at the both ends of the section between stations, detecting track circuit of short length is provided to detect train arriving and departing.

2) Signaling system

Multi-color light signal currently working is applied.

3) Interlocking system

High reliable electronic interlocking system is to be employed.

4) Information transmission system

Information transmission between station masters, between station master and train driver, and among station master, train driver and train dispatcher is especially important for train operation. Therefore, wireless telephone or exclusive telephone for communication between station masters, and wireless telephone for communication among dispatcher, station master and train driver are to be provided.

5) ATS (Automatic Train Stop)

To secure safety of train operation, ATS should be provided all over the railway system.

(3) Transportation management system

To manage all trains in whole railway system safely and efficiently, CTC should be adopted.

CTC (Centralized traffic control) is a system for grasping correct status of train operation which is collected from each station on on-line bases and for remotely controlling route setting in the station.

Therefore, CTC center should be provided with CTC central processor, central display panel to show train location and train number, central control board which remotely controls turnout and signal at each station and train diagram automatic recorder.

Besides, control device should be provided at each station to control turnout and signal individually and independently for necessary case.

CTC centers are installed at Aleppo, Deir el Zor, Homs, Damascus and Lattakia by dividing the whole railway system into five.

Territory of respective CTC center is shown in Fig. 8.7.

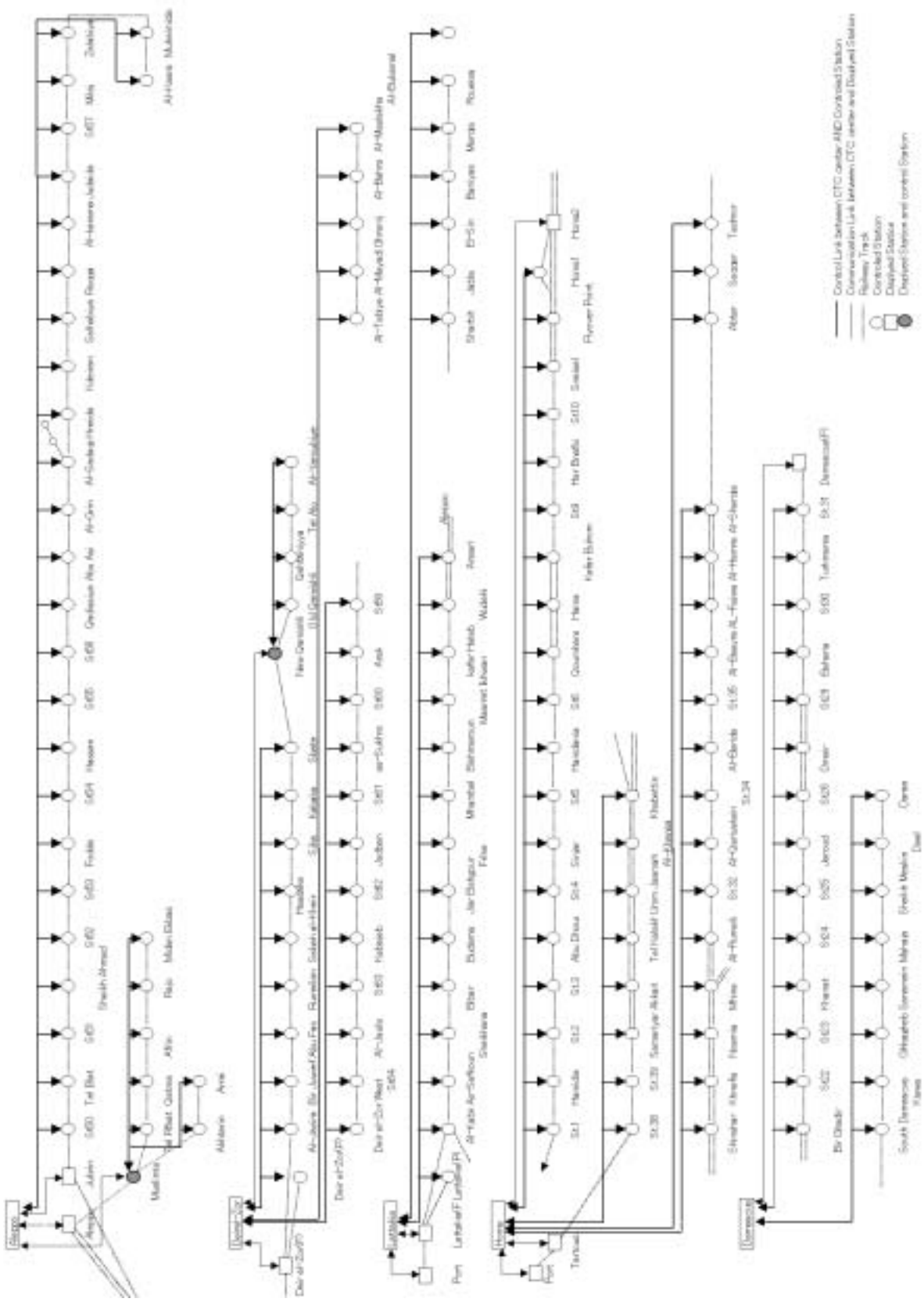


Fig. 8.7 Respective control territory of CTC

(4) Track Capacity improvement plan in accordance with train operation plan

Based on the study of track capacity of lines in accordance with train operation plan, installation of new train crossing facilities (Signal Stations) in single track section, construction of double track, restoration of closed station to make a train crossing station and others are required as shown in Table 8.8.

Furthermore, strengthening of the track to withstand high speed operation, grade separating rail level crossing near "5 kilometerage point", improvement and installation of level crossing safety device and improvement of signal safety device must be executed.

Table 8.8 Improvement plan of track capacity in accordance with train operation plan

Section	Time	Duble Tracking Section	New Signal Station		Restore Closed Station
			Number of Section	Number of station	
Jubrin・ Aleppo～ Damascus	2005	0	0	0	0
	2010	1	2	4	1
	2015	3	9	13	
	2020	0	8	9	1
	Total	4	19	26	2
Mhine～Deir el Zor	2005	0	0		
	2010		5	5	3
	2015	0	2	2	
	2020	0	5	5	
	Total	0	12	12	3
Homs～ Tartous	2005	0	0	0	
	2010	0	2	4	
	2015	0	3	6	
	2020	0	1	2	
	Total	0	6	12	0
Jubrin～ Deirel Zor	2005				
	2010		2	3	1
	2015		2	3	1
	2020				5
	Total	0	4	6	7
Deir el Zor ～Qamishili	2005				
	2010				
	2015				
	2020				4
	Total	0	0	0	4
Wudehi～ Lattakia～ Tartous	2005				
	2010				
	2015				
	2020				3
	Total	0	0	0	3