Chapter 5 The Basic Policy of the Study

5.1 Main Points of the Basic Policy of the Study

In the Study, the master plan is to be prepared in accordance with the following policies, and through consultations with the Syrian side.

(1) Conformity with other development Plans

Ensure conformity with strategic plans of Syria (national development plan, land utililization plan, etc.) and also with projects which GESR and GEHR are planning or implementing.

(2) Target years

Set the target years of the railway development master plan at 2020 for the long-term plan, 2010 for the medium-term plan, and 2005 for the short-term plan.

(3) Realistic and Feasible plan

Draw up realistic and feasible plan entailing an adequate amount of investment, by taking into consideration the economy of Syria and the financial situation of both GESR and GEHR.

(4) Emphasis on the Improvement of Existing Lines and on Economic Feasibility of New Lines

Place emphasis on the rehabilitation and modernization of the existing facilities.

Concerning the expansion of the railway network, pay sufficient attention to national policies and economic feasibility.

(5) Enhance Investment Efficiency

Reduce development costs and enhance investment effects by such measures as planning economical facilities and actively utilizing materials produced in Syria.

(6) Ensure Easy Maintenance

Ensure easy maintenance in the future, by taking into consideration the technical skills

and technical standards of GESR and GEHR.

(7) Attention to Environment Issues

Pay special attention to natural conditions and potential environmental impacts, in planning rehabilitation and modernization of facilities, and development of railway network, and at each stage of schematic design.

(8) Improvement of Management

Provide recommendations on such issues as work efficiency enhancement of employees (education and training), marketing (traffic demand cultivation, project finding, etc.), and financial matters, in order to serve for the management improvement of GESR and GEHR.

(9) Others

The urban railway projects including airport line project, and siding construction projects proposed by the Syrian Railways are all necessary projects for the socio-economic development of the country.

However, the work of master plan formation in the Study of this time will be carried out from the standpoint of nationwide railway network development. In this regard, the urban railway projects including airport line project will not be taken up in the economic and financial analysis of the master plan but related non-quantitative discussion only will be held because the estimation of future railway traffic volume for these projects can not be carried out due to the difference of methods of demand estimation, between the urban transport projects and the nationwide network development projects.

The siding construction projects will be treated in the same way as the urban transport projects because future railway traffic forecast can not be obtained.

5.2 Object Projects of the Master Plan, and Staged Development Plans

5.2.1 General

Based on the results of site surveys and consultations with the Syrian side (refer to Appendix 5.1), the projects of GESR and GEHR to be covered by the master plan have been decided as shown in the following.

5.2.2 GESR

(1) Rehabilitation and Modernization of Existing Facilities Projects

Rehabilitation and modernization of existing facilities projects are composed of the 13 projects shown in the table 5.2.1.

Table 5.2.1 Staged Development Plan
(Rehabilitation and Modernization of Existing Facilities)

No.	Project	Short-term	Medium-term	Long-term	
		2001～2005	2006～2010	2011～2015	2016～2020
1	Midan Ekbas ～Aleppo				
2	Aleppo～Damascus				
3	Aleppo～Lattakia				
4	Lattakia ～Tartous				
5	Tartous ～Homs～Mhine～Al Sharqia				
6	Aleppo ～Deir el-zor				
7	Deir el-zor～Qamishli				
8	Qamishli～Al Yaroubiye				
9	Loco Workshop				
10	Aleppo PC Workshop				
11	Jublin FC Workshop				
12	Freight Information system				
13	Rolling stock procurement				

Legend :

- Substantial Work
- Auxiliary Work
- Signal and telecommunication facilities improvement already committed
- Signal station construction or double tracking conducted to cope with the shortage of the shortage of track capacity due to the increase traffic demand

(2) New Line Construction Projects

New Line Construction projects are composed of the 9 projects shown in the Table 5.2.2.

Table 5.2.2 Staged Development Plan（New Line Construction）

No.	Project	Short-term	Medium-term	Long-term	
		2001～2005	2006～2010	2011～2015	2016～2020
1	Deir el-zor ～Al Bukamal	■			
2	Damascus～Kiswa	■			
	Kiswa～Jordan Border		■	═	═
3	Al Sharqia～Tadmor～Deir el- zor	■	■	┅	┅
4	Adra ～Kabon	■			
5	Maarret Ikhwan ～Edlab	■	■	■	
6	Akkari～Lebanon Border	■			
7	Kadam～Hidjaz station	■	■		
8	West Entrance to Aleppo		■		
9	Rolling stock Procurement	■	■	■	■

Legend :
- ■ Sabstantial Work
- ═ Auxiliary Work
- ┅ Signal station construction to cope with the shortage of track capacity due to the increase traffic demand

5.2.3 GEHR

The projects of GEHR are composed of the following 5 projects as shown in Table 5.2.3.

Table 5.2.3 GEHR Projects

No.	Project	Priority Ranking	Priority Order	Remark
1	Rehabilitation of Darra line and Construction of Kadam-Hidjaz station	A	1	
2	Rehabilitation of Surgaya line	A	2	
3	Rehabilitation of Qatana line and other lines	B	3	
4	Damascus Airport※	(A)		only related qualitative discussion will be provided
5	Tramway			

※ The project is also planned by GESR. Coordination by MOT is desirable.

Chapter 6 Socioeconomic Framework

6.1 Related Development Plans

6.1.1 Central Planning Policy

Since 1960, Syria embarked on eight consecutive five-year economic development plans, the last of which was completed in the year 2000. The ninth 5-year plan is reported to be under preparation. Planning on a regional basis is lacking. Plans exist for the cities of Damascus, Daraa, Tartous, Lattakia and Aleppo to name a few.

In 1980 the development strategy up to the year 2000 was conceived. The main policy issues were:

⇒ Reliance on comprehensive planning
⇒ Determining priorities of economic projects based on market requirements
⇒ Considering the principle of integrated Arab economy
⇒ Placing importance on rural development
⇒ Better utilization of natural resources and improvement of operation conditions
⇒ Encourage private sector participation in industry sector
⇒ In the mining sector increase exploitation of petroleum and gas, phosphate production and iron ore

6.1.2 Development within the last thirty years

(1) Demography

The population data by governorate for the years 1970 and 1997 are reviewed in Table 6.1.1.

Table 6.1.1 Population Data by Governorate

Governorate	Population (1000)		Growth rate (%)		Population density – (1997) (cap/km^2)
	1970	1997	1970	1997	
1. Damascus	831	1,403	4.56	1.8	14,429
2. Damascus Rural	547	1,310	4.88	4.59	105
3. Homs	655	1,546	3.15	3.16	32
4. Hama	583	1,494	3.28	3.3	117
5. Tartous	383	759	3.18	2.19	328
6. Lattakia	467	975	2.79	2.36	346
7. Idlib	490	1,353	2.60	3.48	163
8. Aleppo	1,382	3,922	3.24	3.61	181
9. Raqqa	163	634	3.17	3.59	32
10. Deir el-Zor	337	1,056	2.84	4.36	24
11. Hassaka	352	1,079	2.87	3.31	48
12. As'sweida	202	392	3.45	2.30	51
13. Daraa	267	734	5.30	4.03	183
14. Qunaitra	13	350	3.28	4.88	29
SYRIA total	7,073	17,008	3.35	3.30	82

Source: Central Bureau of Statistics

Compared to the 1970 population, that of 1997 has more than doubled reaching 2.5 times for the whole country. By governorate, the population in the last 30 years has more than tripled in the northeastern governorates of Hassaka, Raqqa and Deir el-Zor and there appears more room for population growth.

(2) Agriculture

Table 6.1.2 shows the structure of the gross domestic product in 30 years.

Table 6.1.2 Structure of Gross Domestic Product (at current prices) (%)

Sectors	1970	1980	1990	1995	1998
1. Agriculture	22	21	28	28	29
2. Mining and manufacturing	20	15	20	14	22
3. Building and construction	3	7	4	4	4
4. Wholesale and retail	20	25	23	26	19
5. Transport and communication	11	7	9	11	12
6. Finance and insurance	11	6	4	5	4
7. Social and personnel services	2	2	2	3	2
8. Government services	11	17	10	9	8
9. Private non-profit services	0	0	0	0	0

Source: Statistical Yearbook, 1999, Central Bureau of Statistics

Agriculture is the largest sector, contributing 29% of GDP in 1998, a share that has remained almost unchanged in the last ten years. The main agricultural crops of cereals, es-

pecially wheat, and barley have significantly increased in the last ten years, as well as the industrial crops such as tobacco and sugar beet.

The total cultivable area is estimated at 5,988 thousand hectares (source: Central Bureau of Statistics, 1998) and that actually cultivated is 4,805 thousand hectares, or 80%.

(3) Industry

As shown in Table 6.1.2 mining and manufacturing sector had a share of 22% of GDP in 1998. This is the highest share in the last 30 years. Many of Syria's industries are agrarian based – such as food processing and textiles. In the mid 1960's the government began a policy of rapid industrialization, especially in iron and steel and other heavy industries.

Although Syria is not a major petroleum producer by Middle East standards, nevertheless petroleum presently accounts for some 40% of total exports and a petrochemical industry has developed around the main refineries. A major oilfield was discovered in the Deir el Zor region in the mid 1980's. Two refineries located at Baniyas and Homs produced 12,221 thousand tons of petroleum products in 1999, 85% of which was consumed locally.

The public sector operates over 100 factories in Syria and its share of the industrial GDP (manufacturing, mining and oil exploitation and electricity and water supply) in 1998 was 63%, with the remainder operated by the private sector. However if the manufacturing category only was considered the private sector share would be 57% of the total. The private sector operated factories are mostly small scale with a smaller number of workers. Table 6.1.3 shows the public sector factories distributed by governorate. The largest numbers of factories are in Damascus and Damascus Rural governorates followed by Aleppo. The urban-industrial axis of Aleppo – Hama – Homs and Damascus has the largest number of factories with about 75% of the total factories concentrated along it.

Table 6.1.3 Public Sector Factories Distribution by Governorate (1998)

Governorate	Industry Sector						Total
	Cement, construction materials	Chemicals	Textiles	Sugar	Engineering goods	Foodstuffs	
Damascus & rural	2	10	8	2	9	6	37
Homs	1	1	2	1	2	1	8
Hama	2	2	2	1	1	2	10
Aleppo	4	5	6	2	3	5	25
Lattakia	1	0	2	0	3	1	7
Tartous	1	0	0	0	0	2	3
Idlib	0	0	1	1	0	1	3
Raqqa	0	0	0	1	0	0	1
Hassaka	0	0	1	0	0	1	2
Daraa	0	2	0	0	0	1	3
Sweida	0	1	1	0	0	1	3
Deir el-Zor	0	1	2	0	0	1	4
Total	11	22	25	8	18	22	106

Source: Ministry of Industry

Table 6.1.4 shows the shares of each industry category for the years 1970, 1984 and 1990 from the net domestic product (NDP) of the industrial sector. Manufacturing industries fell from 80% in 1970 to 33% in 1990 as the mining and crude oil exploitation industry gained foot jumping from 13% in 1970 to 65% of the total in 1990.

Table 6.1.4 NDP shares by industry category (%)

Industry category	1970	1984	1990
Manufacturing industry	80%	46%	33%
Mining and crude oil exploitation	13%	53%	65%
Water, electricity and gas	7%	1%	2%

Source: Economic Growth Factors in Syria, 1950 – 1990, Moheib N. Saleha

6.1.3 Future Development Trend (Governorate Base)

The development potential by governorate is shown in Table 6.1.5.

Table 6.1.5 Analysis of Existing Development Factors in the Syrian Governorates

Development Aspect	Damascus	Damascus Country	Aleppo	Homs	Hama	Idlib	Lattakia	Tartous	Raqqa	Hassaka	Deir el-Zor	Daraa	As Sweida	Qunaitra
1. Further population growth capability (High, Medium, Low)	L	M	M	H	M	M	L	L	H	H	H	M	H	H
2. Economic activity potential (High, Medium, Low)														
Agriculture	L	M	H	H	H	M	L	L	H	H	M	L	L	H
Industry	L	M	L	M	L	L	M	M	H	H	H	M	M	L
Mining and quarrying	L	L	L	H	M	L	L	L	H	H	H	L	L	L
Services (general)	H	H	H	H	M	M	H	M	M	L	L	M	L	L
Tourism	H	M	H	H	M	L	M	M	L	L	L	M	L	M
Export Processing Zone establishment	M	M	H	M	L	L	H	H	L	L	M	H	L	M
3. Availability of urban facilities (High, Medium, Low)														
Educational facilities	H	H	H	H	H	L	H	M	M	L	L	M	L	M
Public sanitary facilities	M	M	M	M	H	M	H	M	L	L	L	M	L	L
Recreation	M	M	M	M	M	M	H	H	M	M	L	L	L	M
4. Outside transport links														
Railway network (Connected, Indirect Connection, No connection)	C	C	C	C	C	I	C	C	C	C	C	C	I	N
Road network (Highway, Main road, Secondary road)	H	H	H	H	H	M	H	H	M	S	M	M	S	S
Maritime routes (Available, NA)	NA	NA	NA	NA	NA	NA	A	A	NA	A	A	NA	NA	NA
4. Environmental conditions (Severe, Medium, Fair)														
Air pollution	S	M	S	S	S	F	M	M	F	M	M	F	F	F
Surface water pollution	S	M	M	M	M	L	H	H	M	H	H	F	F	F
Green areas encroachment	S	S	S	S	S	M	M	F	F	F	F	F	F	M
6. Natural conditions														
Climate (Severe, Fair)	F	F	F	F	F	F	F	F	S	S	S	F	F	F
Topography (Hilly, Flat)	F	F	H	F	F	H	F	F	F	F	F	F	H	H
7. Social conditions (High, Medium, Low)														
Literacy levels	H	M	H	H	H	M	H	M	M	L	L	M	L	M
Urban population	H	M	H	H	H	L	H	H	L	M	M	M	L	L
Close social fabric	M	M	H	H	M	H	L	M	L	L	L	M	L	L

6.2 Economic Future of Syria

6.2.1 Econometric Model Formulation

This econometric model is prepared to foresee the future of Syria. Data used are for the years 1989 till 1999. The prices are adjusted to 1995 constant prices using GDP deflators. Unit of population is 1,000 persons and that for money is one million Syrian Pounds unless otherwise stated. Major concern is to estimate GDP up to year 2020. Control variable of this model is the increase rate of Government Fixed Capital Formation (referred to as "Rig"). Control to Increase of Rig is the "Debt". The maximum Debt Service Ratio to Export is limited at 20%.

6.2.2 Economic Projection

Table 6.2.1 summarizes the simulation output. Export kept its high rate of increase (14.0% p.a.). GDP also maintained its high rate of increase (7.2% p.a.) led by the increase in exports, but GDP/capita showed relatively low increase rate (4.3% p.a.) because of high growth of population (3.2% p.a.). Development Budget showed a slightly high increase (8.7%) compared to GDP. In contrast, Import and Consumption showed stagnant growths, 3.1% and 0.7% respectively.

Table 6.2.1 Major Output from the Model

Year	2000	2005	2010	2015	2020	Annual Increase 2000~2020
Population (1000psn)	16,576	19,384	22,686	26,501	31,070	1.032
GDP Output (mil SP)	817,548	1,112,026	1,560,806	2,248,509	3,312,116	1.072
GDP/Capita (SP/person)	49,321	57,368	68,800	84,846	106,601	1.043
Export (mil SP)	182,231	374,199	751,962	1,413,217	2,508,263	1.140
Import (mil SP)	229,717	255,505	267,762	328,812	422,746	1.031
Consumption (mil SP)	606,622	653,545	686,019	697,567	699,492	1.007
Government Expenditure (mil SP)	232,388	340,384	506,550	762,217	1,155,592	1.087
Development Budget (mil SP)	117,394	178,617	271,489	413,780	625,527	1.087

6.3 Railway Development Budget

6.3.1 Transport Sector Budget between 1991 and 2000

The national budget in the transportation sector for the last ten years was collected. The budget is categorized into Administration Budget and Affiliated Bodies' Budgets (Table 6.3.1).

The share of total expenditures for the transport sector to GDP is 1.5% and the share of railways to total transport sector is 10.2%.

Table 6.3.1 Budget of Transportation Sector (1995 Constant Price)

(unit: MSP)

Organization/Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Transport and Communication	4569	5314	10172	7412	7837	7798	9684	15449	17073	13503
Administration Services	2258	1944	1976	2011	2402	2648	3168	3092	3092	6922
Ministry of Communication	1327	1311	1168	1373	1624	1813	2046	2193	2209	4771
Ministry of Transportation	930	632	807	638	778	835	1121	899	965	2149
Central Administration	368	98	104	91	63	120	237	209	99	117
Gen. Directorate of Air Trans.	521	474	609	461	614	619	776	576	763	1733
Gen. Directorate of Sea Trans.	38	55	90	82	95	90	103	108	96	297
Vocational Schools	2	3	3	3	4	4	4	6	6	2
Affiliated Companies	2310	3370	8196	5390	5435	5149	6516	12357	13899	14928
Petroleum Product Trans.	215	259	422	155	146	141	203	352	664	608
Crude Oil Transportation	53	53	65	57	64	88	133	168	123	213
Telecommunication	977	1167	6093	3520	3812	3162	3479	3893	5330	6124
Post	20	38	43	39	26	44	67	70	56	66
Syrian Railways	472	769	501	526	600	621	758	2255	1854	3995
Al Hejaz Railway	2	3	5	1	1	3	6	5	3	158
Syrian Air Service	26	52	44	40	81	124	737	4002	4752	682
Tartous Port	101	308	196	149	116	133	126	121	97	654
Lattakia Port	134	231	174	149	136	133	126	121	78	969
Shipping Agent	2	3	8	7	6	8	14	15	10	17
Marine Transport	40	70	152	99	7	22	21	21	4	378
Storage and Cooling	47	51	54	113	43	62	71	25	20	28
Grain Silos	67	59	218	359	295	532	716	1242	854	942
Damascus Urban Transport	60	57	49	29	24	13	12	12	12	40
Aleppo Urban Transport	37	28	16	0	6	10	8	10	7	17
Homs Urban Transport	9	14	16	9	7	8	11	8	8	16
Lattakia Urban Transport	12	25	18	8	8	4	4	17	16	18
Al Karnak for trans. and tourism	20	166	109	121	57	35	2	6	0	0
Military Trans. Establishment	6	5	4	0	0	0	0	0	0	0
Sea Transport	0	1	0	1	0	0	15	6	4	1

Note: Increase Rate is calculated from Budgets of 1000 SP unit

6.3.2 Shares of GESR and GEHR Budgets within Government Expenditure

The shares of both GEHR and GESR budgets to the total Government Expenditure are calculated and summarized in Table 6.3.2.

Table 6.3.2 Shares of GESR and GEHR Budgets to Government Expenditure

(Unit: in 1995 prices, million SP)

Item/ Year	1991	1992	1993	1994	1995	1996	1997	1998
Gov't Expenditure (GE)	114,233	119,386	149,120	153,798	162,040	166,830	177,875	201,945
Syrian Railways (GESR)	472	769	501	525	600	621	758	2255
Al Hejaz Railway (GEHR)	2.7	3.8	5.5	1.6	0.5	3.3	6.7	5.1
Share of GESR in GE	0.00413	0.00644	0.00336	0.00341	0.00370	0.00372	0.00426	0.01117
Share of GEHR in GE	0.00003	0.00005	0.00001	0.00000	0.00002	0.00004	0.00003	0.00002

The regression analysis of both GESR budget and Government Expenditure, and GEHR budget and Government Expenditure result in the following outputs.

GESR (in MSP of 1995 constant price)
GESR budget = 6000 / (1+97.79165exp(-0.0000165Government Expenditure)), r^2=0.791

GHHR (in MSP of 1995 constant price)
No statistically assured formula was obtained due to random nature of data.

Based on the formula mentioned above, the future budget for GESR was estimated as shown in Table 6.3.3. The total of GESR budget for the master plan period (2002 – 2020) is 165,471 million SP (2000 Constant Price).

Table 6.3.3 Budget Estimates of GESR

Year	1995 Constant Price, million SP.		2000 Constant Price, million SP.	
	Gov't. Expenditure	GESR Budget	Gov't. Expenditure	GESR Budget
2001	250,433	2,335	407,473	3,800
2002	270,103	2,811	439,477	4,574
2003	291,542	3,340	474,361	5,434
2004	314,912	3,892	512,385	6,333
2005	340,384	4,426	553,830	7,201
2006	368,149	4,898	599,006	7,969
2007	398,413	5,279	648,248	8,589
2008	431,401	5,559	701,921	9,046
2009	467,358	5,748	760,425	9,353
2010	506,550	5,865	824,195	9,544
2011	549,270	5,933	893,704	9,653
2012	595,835	5,969	969,468	9,711
2013	646,591	5,986	1,052,051	9,740
2014	701,914	5,995	1,142,067	9,754
2015	762,217	5,998	1,240,184	9,759
2016	827,947	5,999	1,347,132	9,761
2017	899,593	6,000	1,463,705	9,762
2018	977,687	6,000	1,590,769	9,762
2019	1,062,809	6,000	1,729,270	9,762
2020	1,155,592	6,000	1,880,235	9,762
Total	11,818,700	104,033	19,229,906	169,269

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 Main Report and Appendix under the same chapter numbering.

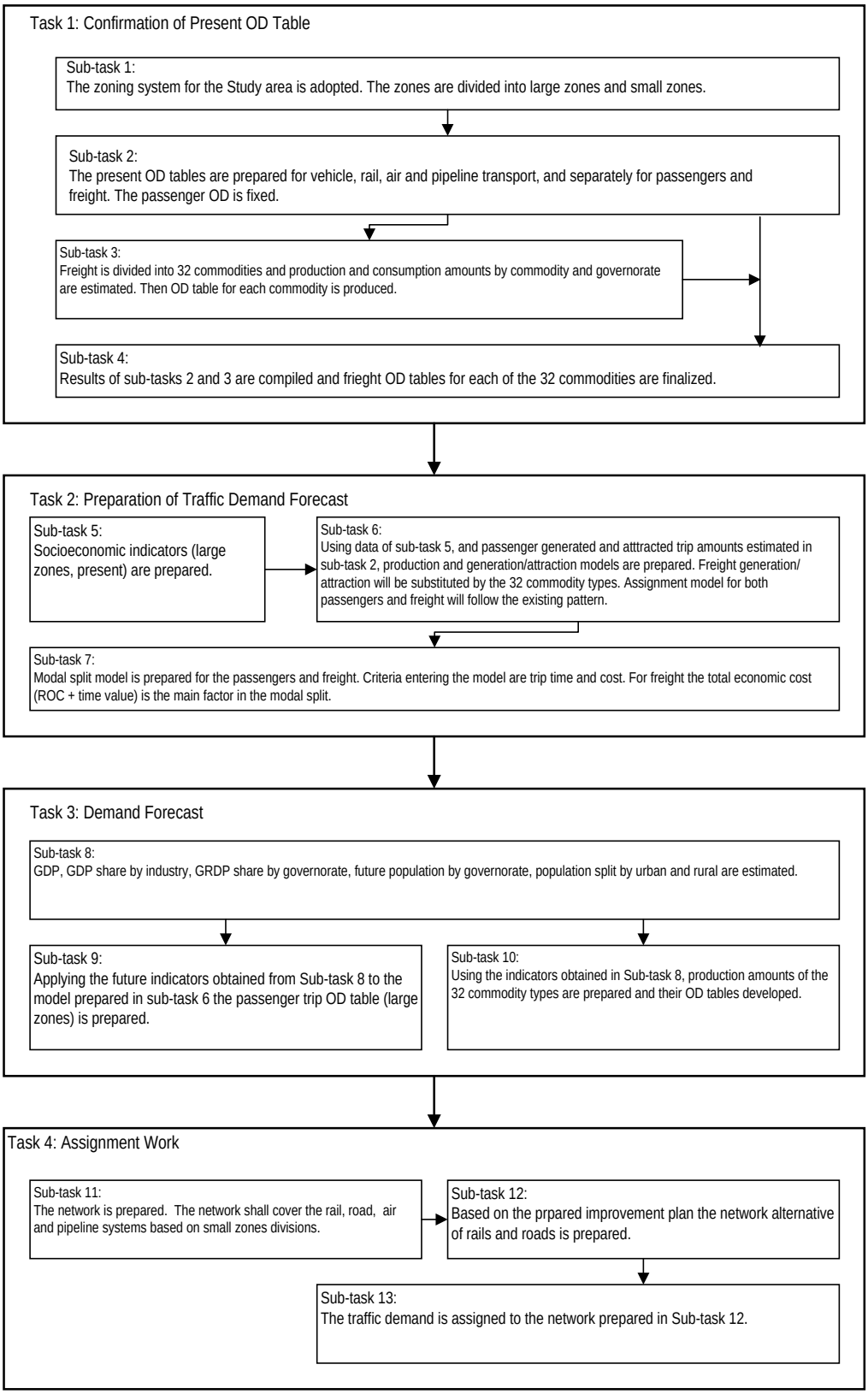

Figure 7.1.1 Flow Chart for Demand Forecast Work

7.2 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.

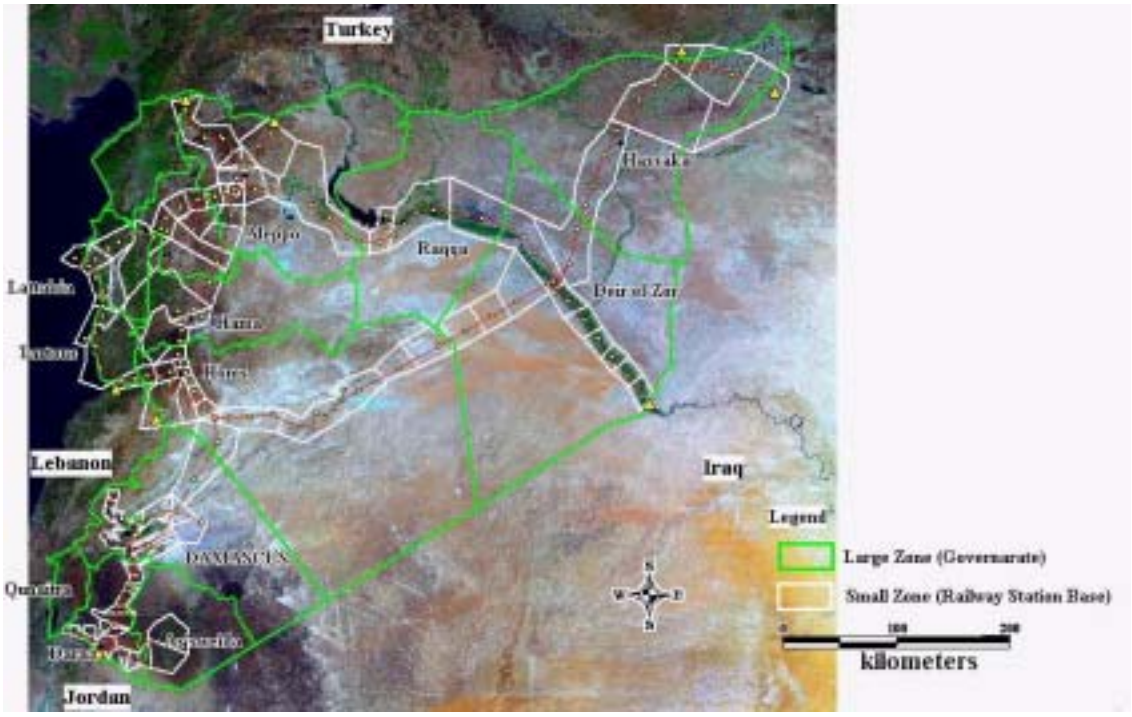

Figure 7.2.1 Large and Small Zones Map

7.3 OD (Large Zone, 1999)

7.3.1 Passenger

Road passenger OD obtained from road traffic observation at the Governorate borders and Rail passenger OD represents 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 for the Damascus Urban Transport Study, JICA 1997-1999.

7.3.2 Freight

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

b) 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.

7.4 Model

7.4.1 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 (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 zone passengers OD pairs the trip production figure of 0.0298 trip/person shall be used and for the large zone intra-zonal trip production rate the figure of 0.437 trip/person is used.

Trip Production and Trip Generation/Attraction Models of Freight are not prepared due to existence of the production/consumption projection, as explained in the following section 7.4.2.

7.4.2 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

7.4.3 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).

7.4.4 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 7.4.1.

Table 7.4.1 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 (ref. Table 7.4.2). 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 7.4.2 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 using the modal choice survey result summarized in Table 7.4.3

Table 7.4.3 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 7.4.3 are fare and speed. Converted time of travel cost was formulated using the said 100 samples on difference of travel time of two transport modes (train and bus) and difference of travel cost (fare).

$-0.0349 \times TT + 0.02768\ TC + 3.031829 = 0$ ……(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).

Assume "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)

(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 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 principal 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.

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.

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 7.4.4 show that with the exception of phosphates rail transport of most commodities is are prefer to use trucks.

Table 7.4.4 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 $f(n_i)$ depends on the commodity i. General pattern of f(n) is as follows;

Table 7.4.5 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

7.5 Demand Forecast

7.5.1 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 7.5.1 for population, followed by Table 7.5.2, 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 7.5.1 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 7.5.2 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 7.5.3.

Table 7.5.3 Distribution of Freight Attraction and Distribution Volumes on Small Zones

	Commodity 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

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

(1) Passengers

The passenger indicators described in section 7.5.1 were applied to the model detailed in section 7.4 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.

(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 7.5.4 provisional figures for future transport demands were prepared. In a different way the estimated future GDP by industry sector (Table 7.5.5 shows the estimation formulas for the GDP and Table 7.5.6 the estimates) were used as control totals and after adjustment the future traffic demand volumes were fixed.

Table 7.5.4 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 7.5.5 Coefficients for Estimation of GDP by Industrial Sector

Item/Year	Constant	Population	GDP	GDP/cap	R2
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 7.5.6 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

(3) Summation of Traffic Demand

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 7.5.7).

Passenger and freight demand in 2020 are shown in Figures 7.51 and 2, respectively.

Table 7.5.7 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
on-km/day	51,509,893	73,191,522	107,202,860	162,601,950	245,610,890

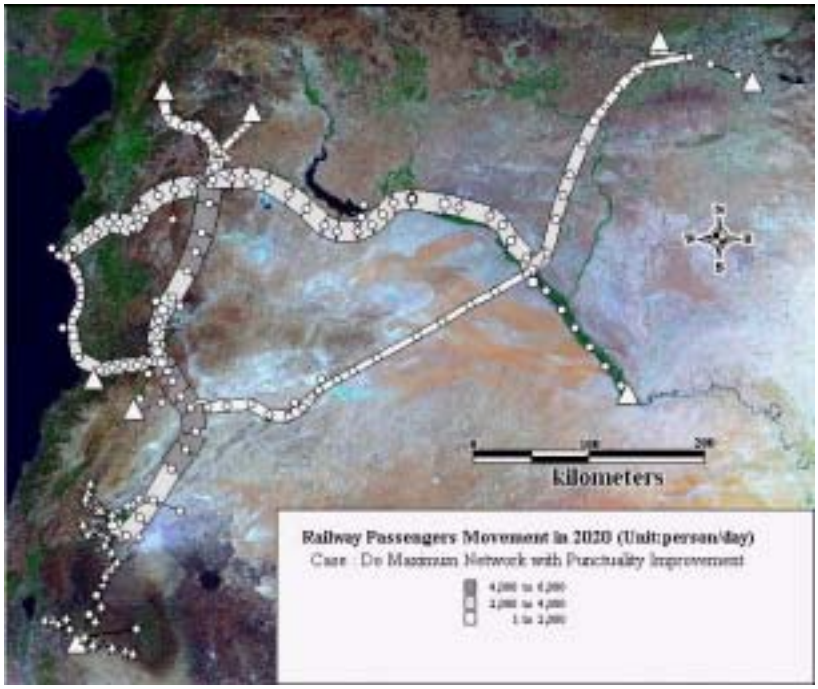

Figure 7.5.1 Passenger railway traffic assignment in 2020 (do maximum)

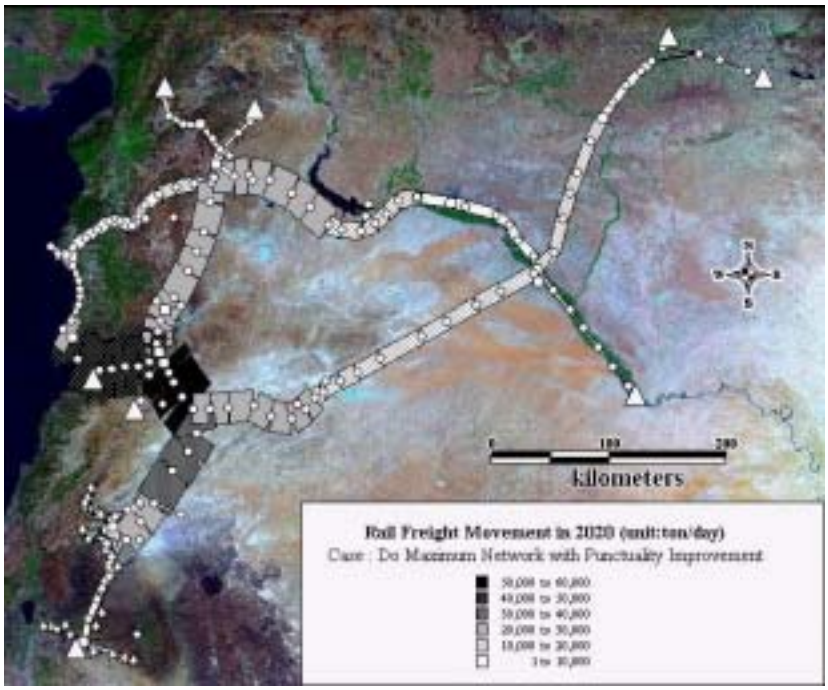

Figure 7.5.2 Freight railway traffic assignment in 2020 (do maximum)

Chapter 8 Transportation plan

8.1 Fundamental premises for setting up transportation plan

(1) Targeted lines and operating speed

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) Signaling system

Signaling system is an automatic blocking system.

(3) Driving power system

As for powering system, diesel engine is adopted. Overnight sleeper train and a part of daytime train are to be hauled by diesel electric locomotive (DEL), but as a rule, day time operating train is to be by diesel railcar (DC) train.

(4) Train formation

1) Passenger train

Referring 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 one of DC train is 1～5 cars considering frequent service.

2) Freight train

The single headed operation is the principle of freight train and hauling capacity is to

be 1,400～2,000 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.

(5) Rolling stock and its characteristics

All of the train except sleeper train and a part of day time train is formed by only DC with possible maximum speed of 130km/h.

In case of locomotives, expecting they are to be unified with high output locomotives.

(6) Transportation demand

Result of transportation demand study is as follows.

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

(7) Riding factor and hauling factor

1) Riding factor

The riding factor of passenger train is premised as 70%. 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%

8.2 Transportation plan

(1) Train operation plan

1) Passenger train operation plan

Passenger train is planned as in Table 8.2.

Table 8.2 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

2) Freight train operation plan

Yearly and sectional train operation plan is as indicated in Table 8.3.

Table 8.3 Yearly and sectional train operation plan

Year			Houling	2005			2010			2015			2020		
Section			Capacity	Phasphate	Other	Total	Phasphate	Other	Total	Phasphate	Other	Total	Phasphate	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.

3) Train kilometer and car kilometer

Table 8.4 indicates daily train kilometer and car kilometer calculated by yearly

transportation plan.

Table 8.4 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) New train crossing facilities by train operation plan

Based on the study of track capacity of lines in accordance with train operation plan, installation of new train crossing facilities in single track section construction of double track, restoration of closed station to make a train crossing station and others are required. For the others, strengthening of the track to withstand high speed operation, grade separating rail level crossing near “5 kilometer age point”, improvement and installation of level crossing safety device and improvement signal safety device must be executed.

Chapter 9 Improvement plan of rolling stock, workshop and depot

9.1 Improvement concept for rolling stock, workshop and depot

9.1.1 Rolling stock

(1) The diesel cars will be used for the passenger train mainly in the domestic transportation.

(2) Locomotive will be used for freight trains, night passenger trains mainly in the domestic transportation and international passenger trains.

9.1.2 Workshop and depot

(1) Locomotive and diesel cars will be repaired at the same workshop.

(2) New maintenance/repair machines and new testing equipments for diesel cars will be introduced at the existing locomotive depot.

9.2 Necessary numbers of rolling stock and increase plan of rolling stock

Type		2005 year	2010 year	2015 year	2020 year
Locomotive	Necessary numbers	116	151	240	370
	Increase plan	50	35	119(19)	155(49)
Diesel car	Necessary numbers	55	85	195	290
	Increase plan	55	30	110	95
Passenger coach	Necessary numbers	190	190	140	140
	Increase plan	3	4	119	0
Freight wagon	Necessary numbers	5,000	7,500	10,800	18,000
	Increase plan	133	2,582	3,300	7,328

Note: Numbers in parentheses are for the included LED2800s which will be used for shunting after repair among the non use LDE2800 fleet.

9.3 Improvement plan of workshop and depot

(1) Future inspection cycle and place

1) Locomotive

Type	M1	M2	M3	M4	M5	M6
LDE3200 LDE2800 LDE1800 LDE1500 LDE1200	Before used	3 days	3 months or 30,000 km	1.5 years or 150,000 km	3 years or 300,000 km	6 years or 600,000 km
	Depot	Depot	Depot	Depot	Workshop	Workshop
LDE650	Before used	3 days	3 months	6 months	-	-
	Depot	Depot	Depot	Depot		

2) Diesel car

Type	D1	D2	D3	D4	D5	D6
All	Before used	3 days	3 months or 50,000 km	1.5 years or 150,000 km	3 years or 300,000 km	6 years or 600,000 km
	Depot	Depot	Depot	Depot	Workshop	Workshop

3) Passenger coach

Type	T1	T2	T3
All	Before used	3 months	5 years
	Depot	Depot	Workshop

4) Freight wagon

Type	F1	F2	F3
All	Before used	3 months	6 years
	Depot	Depot	Workshop

(2) Future standard process of periodical inspection

1) Workshop

Standard process (necessary days for inspection) of periodical inspection at workshop was settled as follows, in consideration of the modernized facilities and equipment of workshop, preparation of spare parts etc.

(Actual working day)

Periodical inspection	DL		DC		PC		FC	
M5, M6, D5	M5	30	D5	22	T3	30	F3	10
D6, T3, F3	M6	40	D6	30				

2) Depot

Standard days and hours necessary to periodical inspection at depot were settled respectively, for M1～M4 of DL, D1～D4 of DC, T1 & T2 of PC and F1 & F2 of FC.

(3) Machinery and testing device necessary to inspection

Those in workshops and depots were planned. (Contents were omitted.)

(4) Education and training necessary to the staff concerned in inspection

Those in workshops and depots were planned. (Contents were omitted.)

9.4 Staged improvement plan

9.4.1 Cost for rolling stock

(Unit : Million SP)

Type		2001-2005	2006-2010	2011-2015	2016-2020	Amounts of cost
Locomotive	Numbers	20	33	100*	106*	259
	Amounts	2,832	3,036	8,090	9,530	23,488
Diesel car	Numbers	55	30	110	95	226
	Amounts	2,530	1,380	5,060	4,370	13,340
Passenger coach	Numbers	3	4	119	0	126
	Amounts	96	128	3,444	0	3,668
Freight wagon	Numbers	133	2,582	3,300	7,328	13,343
	Amounts	269	3,318	4,191	9,685	17,463
Amount of cost	Numbers	211	2,649	3,565	7,529	13,954
	Amounts	5,727	7,862	20,785	23,585	57,959

Note: * The figures are decreased by the numbers in parentheses in table of paragraph 9.2.

9.4.2 Workshop and depot

(Unit : Million SP)

Year	Content	Amounts of cost	Total
2001 to 2005	1.Construction of locomotive & diesel car workshop	7,691.4	13,210.4
	2.Change of location of locomotive depot	1,000	
	3.Construction of passenger coach workshop	3,600	
	4.Equipment of diesel car depot	504	
	5.Construction of locomotive depot	415	
2006 to 2010	1.Construction of locomotive & diesel car workshop	743.5	3,643.5
	2.Modernization of freight wagon workshop	2,350	
	3.Equipment of diesel car depot	506	
	4.Modernization of locomotive depot	46	
2011 to 2015	1.Construction of locomotive & diesel car workshop	16.6	5,166.6
	2.Construction of freight wagon workshop	4,600	
	3.Equipment of diesel car depot	504	
	4.Modernization of locomotive depot	46	
2016 to 2020	1.Equipment of diesel car depot	504	550
	2.Modernization of locomotive depot	46	
Total			22,570.5

Chapter 10 Improvement Plan of Railway Facilities

10.1 Concept of Arrangement of Improvement Plan

Basic policy for track facility improvement is to keep maintain the current Russian standard of 3rd class lines and adopt 2nd class track standard depending on the section. As for adoption of new track materials for improvement, it is planned to use materials corresponding to UIC standard. Main specifications are as follows;

		Train	New Line	Existing Line
・ Design Train Speed (Maximum)	Alignment	Passenger	250km/h	130km/h
		Freight	140km/h	100km/h
	Track	Passenger	160km/h	120km/h
		Freight	120km/h	100km/h
・ Train Operating Speed (Max.)		Passenger	130km/h	130km/h
		Freight	100km/h	100km/h
・ Track Gauge			1,435mm	
・ Minimum Radius Curve			R=4,500m	R=600m
When required			R=600m	R=300m
・ Maximum Cant			150mm	
・ Maximum Slack			20mm	
・ Maximum Gradient			8.0‰	12.0‰
Where required			12.0‰	20.0‰
・ Design Load			UIC 702, Axle load 25ton	
・ Rail			UIC 60 (60.3kg/m)	
・ Sleeper			PC Sleeper(UIC B70),length 2,600mm	
			No. of sleeper 1,540－1,667/km	
・ Fastening			Pandrol with elastic pad	
・ Track bed	Crushed stone, under sleeper more than		300mm	250mm
・ Turnout		Main Track	# 14 or larger No.	# 11
		Side Track	# 9	# 9
・ Line to line length	Between station		5.0m	
	Station yard		5.0－6.5m	
・ Track formation width		Single track	7.0－7.5m	
		Double track	12.0－12.5m	

In the first place, improvement of track shall be executed for each section and to secure the track capacity according to the traffic demand, construction of new signal station or double tracking will be executed. However, track maintenance condition of each section is poor and not adequate for train operation with the originally planned train speed although 20 - 30 years had already elapsed since the line had been opened for service. In order to upgrade the maintenance condition, track rehabilitation of all sections shall be made as far as practical at the beginning of line improvement plan.

The section of each project is as shown in Fig.10.1.1

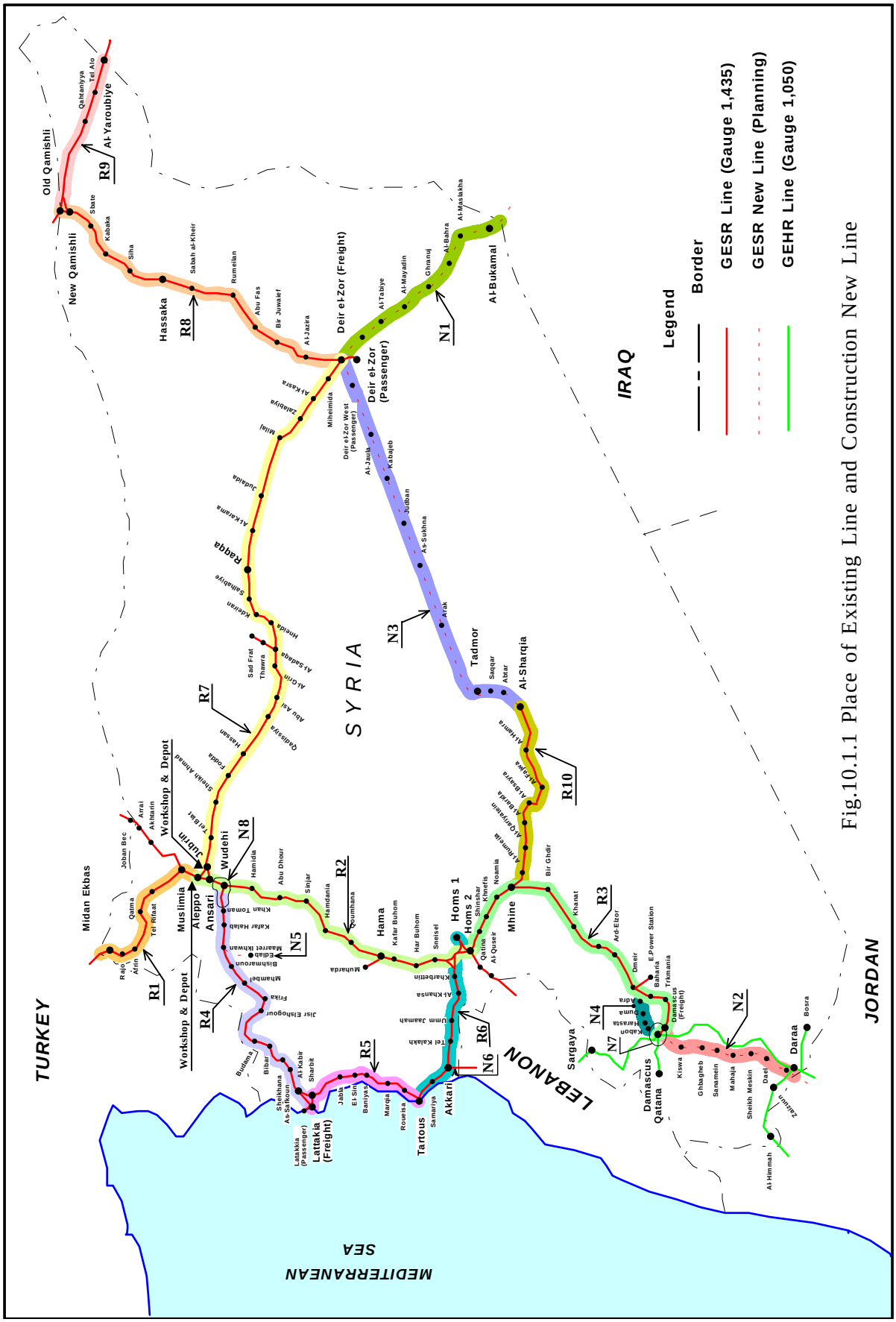

Fig.10.1.1 Place of Existing Line and Construction New Line

10.2 Track Facilities Improvement Plan

10.2.1 Track Capacity Strengthening Plan

To secure track capacity, signal stations should be installed between the present stations coping with the increase of number of trains. But in order to raise effectiveness, it is needed to divide the section between stations into 2 or 3 equal parts.

However, depending on track alignment, to install signal stations at equally spaced position between the current stations will be very difficult and the construction cost will become very high.

Consequently, in installing signal stations, it should be installed at places near to the roughly equally divided positions without altering the present alignment.

Design condition of signal station is ;

- Gradient : less than 3.0‰
- Curve Radius : more than 600m
- effective track length : more than 650m

and, if the above conditions are not satisfied, double tracking should be executed.

Improvement details of each section are as shown in Table 10.11. (Refer to Appendix 3.3.1, Appendix 10.1, 10.2)

Table 10.1.1 Improvement Plan of Each Line

No.	Line Name	Distance (km)	No. of Station	No. of New Signal Station	Double Tracking	Improvement of Alignment (km)
R1	Midan Ekbas ～Aleppo	133.2	7	—	—	80.0
R2	Aleppo～Homs	202.2	14	8(10)	37.0	—
R3	Homs～Damascus	202.6	13	7 (21)	112.4	—
R4	Aleppo～Lattakia	210.8	16	—	—	—
R5	Lattakia ～ Tartuos	79.0	7	—	—	—
R6	Tartous～Homs	102.0	7	2 (12)	45.9	39.4
R7	Aleppo～Deir el-Zor	323.0	21	8 (8)	—	—
R8	Deir el-Zor～Qamishli	217.5	11	—	—	—
R9	Qamishli～Al Yaroubiye	79.4	3	—	—	—
R10	Mihine～Al Sharqia	110.7	7	3 (6)	41.2	—
	Total	1,660.4	106	28 (57)	236.5	119.4

Note: Number in ( ) indicate number of necessary signal stations in case of single track (to correspond to the number of train until year 2020.)

(1) Signal Station

On the left and right side of the present track, track will be installed with track spacing of 5m with 650 meters of track effective length and will be connected to the present track with # 11 turnout. Track usage direction is right-hand passage as principle and safety-siding is installed on head direction. Tracks laid on left and right side can be used as refuge line of pass-by train and existing track in the middle will be used as common passing track.

Standardized signal station is shown in Fig 10.2.1.

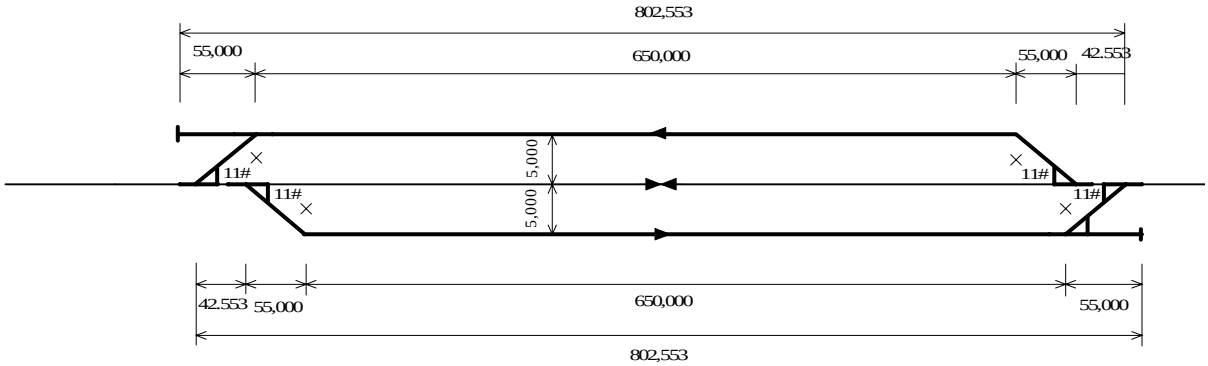

Fig 10.2.1 Standard Layout of Signal Station

(2) Double Tracking

In parallel with the present track between stations, the second track will be laid with 5.0m of track spacing. Considering right hand operation of road traffic and right side locomotive engineer's seat, right side passage train has been adopted in principle.

Standardized cross section of the double track is shown in Fig. 10.2.2.

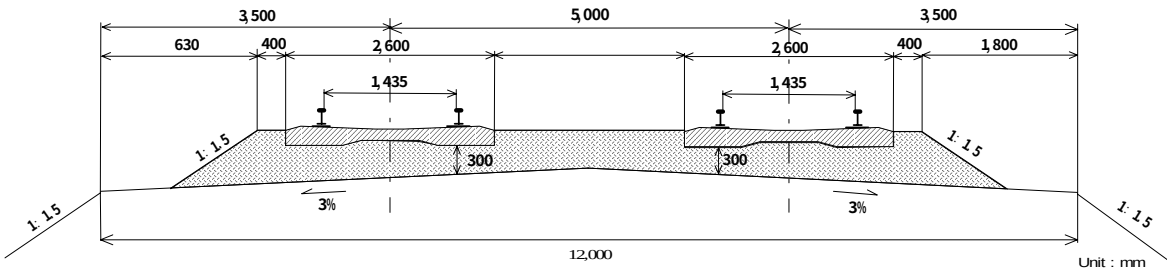

Fig 10.2.2 Cross section of Double Track (Straight Line)

10.2.2 Track Improvement

In order to grasp the present track condition, total track measuring of GESR should be performed and alignment control ledger should be prepared.

Alignment actually measured shall be compared with the original ones, post shall be installed and revision of alignment should be made according to this post.

(1) Rail

P 50 rail will be continued to be used in the same way as at present on main line and for Aleppo-Midan Ekbas and Qamishli- Al-Yaroubiye sections where 37kg/m or 43kg/m rail is used, these rails should be replaced by rail of more than 50kg/m.

(2) Fastening and Sleeper

Some of the plugs used for PC sleeper fastening are wooden made and many are not well functioned because of construction deteriorated due to their dryness and corrosion. Especially, at rail joint point, sleeper itself is deteriorated and will have to be replaced with new sleeper and with respect to fastening devices, replacement by coil spring is now under introduction.

Between Aleppo-Midan Ekbas and Qamishli- Al Yaroubiye, iron-sleepers are still remained and will be replaced with PC sleeper at the time when rails are to be exchanged.

(3) Turnout

At present, passing speed at turnouts is all restricted to 30-40 km/h regardless of straight side or branching side. In general, speed restriction are placed on branching side, but no restriction is placed on straight side. This speed restriction on straight side occurs because maintenance of turnouts and replacement of worn-out parts are not fully performed.

All track ballast at turnout section should be replaced to keep turnout surface plane precisely, and worn out parts, particularly the point rail, crossing and guard rail should be replaced to enable to release the speed restriction on straight line side.

(4) Roadbed

It was observed that many places on main track in railway station were covered by earth and sands.

For these places, whole replacement of ballast should be enforced to secure the formal ballast depth. And also at places between stations having the same conditions, whole replacement of ballast should be enforced.

There are places where ballast are falling down on roadbed slope at embankment because of track formation shortage or increased ballast depth. At some places, even the sleeper-edges are exposed. Especially, at the outside of curved track, there are many such cases seen which may lead to stretch out of track. It is needed to expand the width of track formation, or placing ballast stopper (L type concrete block etc.) can secure the width of ballast of sleeper's edge. (Fig10.2.3)

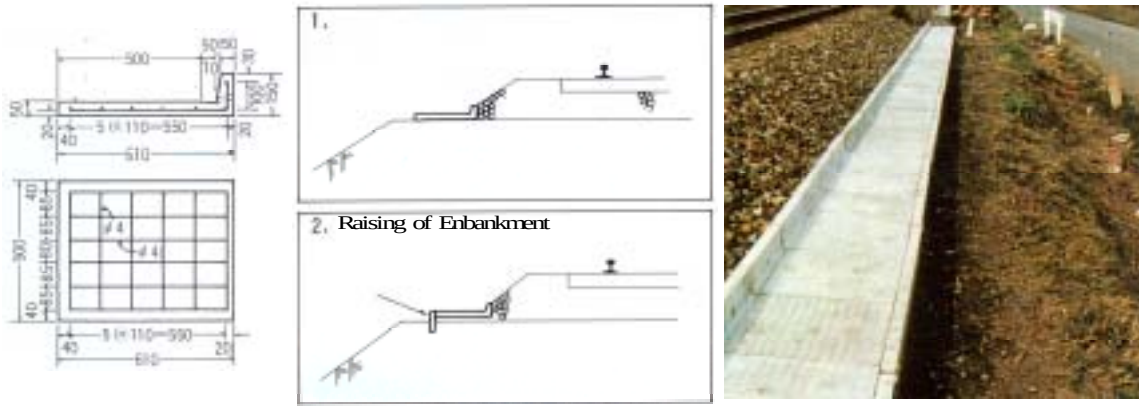

Fig.10.2.3 Ballast curb of L Type concrete block

10.2.3 Railway Level Crossing

There are many railway level crossings where crossing parts are all paved in the same way as the road and it is unable to execute track maintenance. It is, therefore, necessary to improve the level crossing portion as shown in Fig 10.2.4 so as to enable the maintenance.
There are places where the width of level crossing is narrower than road width. Enough width to accord with road traffic should be secured. (Refer to Appendix 10.3)

There are many places seen where inhabitants illegally cross the tracks causing tracks covered

with earth and sands. These illegal railway crossings should be removed so as to enable railway to fully exhibit its function. If it is necessary, formal railway level crossing should be installed.

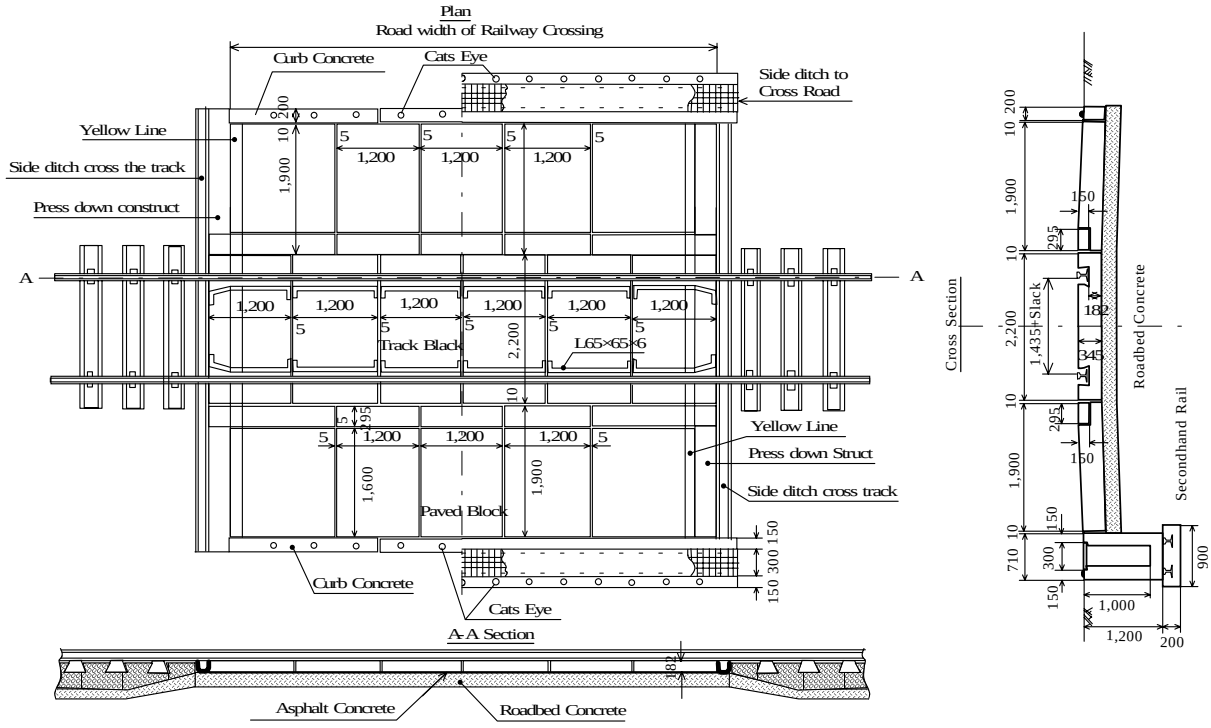

Fig.10.2.4 Railway Level Crossing

10.2.4 Structure

Structures, owing to the short years since construction, are at present fully functioning. Some time later, however, chances are coming to need to make repairing because of the deterioration. Each structure must be checked on changed condition and check results should be recorded on control ledger.

Because of the weathering of track bed slope and consolidation depression of track formation, reduction of formation width is seen on embankment. As a result of re-ballasting for settlement of track formation, ballasts flow out from the slope. For the time-being, it is possible to keep the track ballast width by the means of the ballast-stop device. However, it is most desirable to keep the regular track formation width by expanding the roadbed width.

As for the bridges between Aleppo-Midan Ekbas and Qamishli-Al-Yaroubiye, they are open floor non-ballast type and those on the other lines are all closed floor ballasted bridges.

Bridges with ballast are of narrow width and ballast flow out. It seems that formal ballast amount causes large dead-weight of closed floor type bridge, accordingly that the usage of PC sleepers are restricted. As a countermeasures, solid bed track may be introduced. There are many types of solid bed track. Elastically supported PC sleeper type as shown in Fig10.2.5 is recommendable.

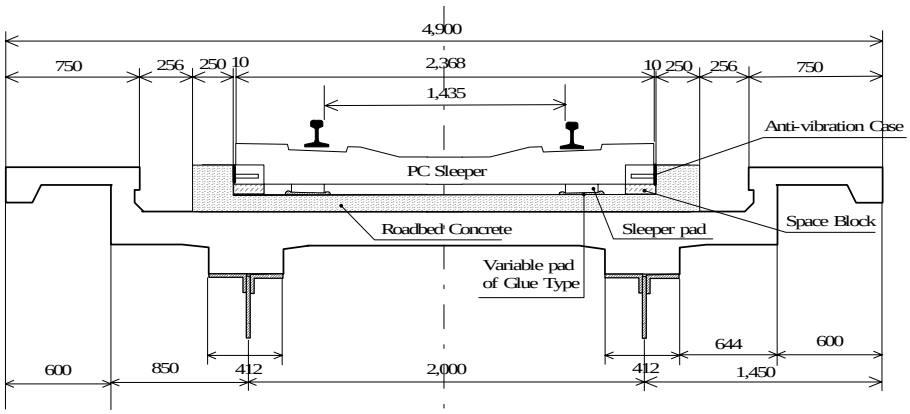

Fig.10.2.5 Elastically Supported PC Sleeper

10.2.5. Protection Facilities

(1) Sand Protection Measure

Cutting section is apt to become the place where drift sand is accumulated. Cutting slope should be made small. Also, in Syria, tree planting and cultivation of farm products are now promoted for sand protection. For implementing such measures, soil improvement along the line of sand protection section must be progressed. And also it is necessary to grasp meteorological information and to allocate track patrol staff in the sand drifting section.

(2) Fencing for Trespassing Railway Track

At the densely built-up section, tracks are partly used as living road. This is not only dangerous for human life but also disturbs train operation, and also destructs the well maintained track condition.

Protection fence should be installed to avoid the above adverse situations.

(3) In order to make clear the width of railway level crossing, fence using old rail should be installed.

10.2.6 Staged Improvement Plan

(1) Schedule

New installation of signal station and double tracking construction works should be planned so as to be completed by the time when track capacity increase is required.

Track improvement on the whole sections is so planned as to be completed in 5 years from the beginning of the Project.

Table 10.2.2 Table of Improvement Schedule

No.	Line Name	Schdule 2000 2005 2010 2015 2020	Railway Maintenance (km)	No. of New Signal Station	Double Tracking Length (km)	Improvement of Alinment (km)
R1	Midan Ekbas – Aleppo		133.2	—	—	80.0
R2	Aleppo – Homs		202.2	8	37.0	39.4
R3	Homs – Damascus		202.6	7	112.4	
R4	Aleppo – Lattakia		210.8	—	—	
R5	Lattakia – Tatous		79.0	—	—	
R6	Tartous – Homs		102.0	2	45.9	
R7	Aleppo – Deir el-Zor		323.0	8	—	
R8	Deir el-Zor – Qamishli		217.5	—	—	
R9	Qamishli – Al Yaroubiye		79.4	—	—	
R10	Mihine – Al Sharqia		110.7	3	41.2	
	Total		1,660.4	28	236.5	119.4

(2) Improvement Cost

Itemized improvement cost and investment schedule by lines is shown in Table 10.2.3.

Table 10.2.3 Cost and Investment Schedule

Unit : Million SP

Line	Item	2001-2005	2006-2010	2011-2015	2016-2020	Total
R1 Midan Ekbas-Aleppo	Land	478	0	0	0	478
	Roadbed	3,127	2,550	0	0	5,677
	Track	797	1,438	0	0	2,235
	Total	4,402	3,988	0	0	8,390
R2 Aleppo-Homs	Land	0	31	1	32	64
	Roadbed	0	430	23	233	686
	Track	936	685	255	812	2,688
	Total	936	1,146	279	1,077	3,438
R3 Homs-Damascus	Land	0	56	61	19	136
	Roadbed	0	367	425	132	924
	Track	964	1,205	1,442	429	4,040
	Total	964	1,628	1,928	580	5,100
R4 Aleppo-Lattakia	Land	0	0	0	0	0
	Roadbed	0	0	0	0	0
	Track	941	0	0	0	941
	Total	941	0	0	0	941
R5 Lattakia-Tartous	Land	0	0	0	0	0
	Roadbed	0	0	0	0	0
	Track	422	0	0	0	422
	Total	422	0	0	0	422
R6 Taltous-Homs	Land	0	107	117	3	227
	Roadbed	0	633	697	45	1,375
	Track	922	2,129	2,342	128	5,521
	Total	922	2,869	3,156	176	7,123
R7 Aleppo-Deir el-Zor	Land	0	0	3	7	10
	Roadbed	0	0	45	137	182
	Track	1,632	0	128	384	2,144
	Total	1,632	0	176	528	2,336
R8 Deir el-Zor-Qamishli	Land	0	0	0	0	0
	Roadbed	0	0	0	0	0
	Track	998	0	410	410	1,818
	Total	998	0	410	410	1,818
R9 Qamishli-Al-Yaroubiye	Land	0	0	0	0	0
	Roadbed	0	0	0	0	0
	Track	0	0	825	835	1,660
	Total	0	0	825	835	1,660
R10 Mihine-Al - Sharqia	Land	0	53	1	0	54
	Roadbed	0	346	23	0	369
	Track	531	1,137	64	0	1,732
	Total	531	1,536	88	0	2,155
Ground Total		11,748	11,167	6,862	3,606	33,383

(3) Others

In accordance with progress of rehabilitation of existing lines, used rails will be generated. Out of these used rails, undamaged ones can be used for improvement or construction of other branch lines or sidings such as Qatana Line, industrial sidings, etc., in order to save cost of rail.

10.3 Maintenance System

For 30 years the Russian railway technology was brought up but after Russia's withdrawal, it is the time to establish the railway standard of Syrian Railways.

10.3.1 Maintenance Organization

(1) Head Office, Each Railway Operating Division

The post exclusively handling track and structure control should be strengthened so as for the engineers in charge to be able to grasp the updated conditions of track and structures.

(2) Field Organization (track maintenance depot and track maintenance group)

Also within the field organization, engineers assigned exclusively for track and structure control must be strengthened in same way as in operating divisions, so as to grasp updated conditions of the site.

Track maintenance work is done by internal workers and one gang consisting of 9-12 workers is assigned for every 20-25km responsible section and there are 92 Gang Groups in total in GESR. Hereafter, maintenance volume will be increased according to the increasing number of train operations. Review on track maintenance work system is necessary, so as to enable some work to be entrusted outside.

10.3.2 Arrangement of Various Regulations, Control Ledger and Maintenance Work Process

By Russian Railway's technical rules and regulations, railway construction and maintenance have been made up to now. However, in order to make railway transport more stable, rules, regulations and standard of Syrian Railways must be established.

(1) Rearrangement of various regulations

Official regulations can be divided into 3 items as follows:

・Rule　To stipulate the minimum requirements of track and structure in order to secure the safety of railway transport. Therefore, the limit which was decided in this Rule can not be violated.

・Regulation　Can be divided into Regulation and Standard rule.
Regulation is established for new line construction, improvement and maintenance of rail way facilities.
Standard rule is the rule for handling process of track and structure.

・Standard　For every regulations, each working method, handling procedures are defined in detail.

(2) Rearrangement of Various Control Ledger

To grasp the up-dated condition, it is proposed to have numerical value control using statistics analysis of 5 items (rail gauge, track level, longitudinal level, alignment and track distortion) to show the track condition. (Appendix 10.4)

In addition to the above, kind of track material, historic data of track material, deterioration condition of track material and materials necessary to secure safety operation of train are the items to be arranged.

Also for structure control, in order to secure safety operation of train, completion drawing, design calculation paper and volume of material for every one by one item must be edited.

At present, track inspection/measuring car is introduced to grasp track conditions, but this inspection/measuring car has already been used for more than 10 several years. Measuring car with new measuring devices enabling compilation and analysis of the results of measuring should be introduced.

(3) Maintenance Work Process

On track maintenance, special and various kind of machines or measuring equipments are to be used. If these equipments are used wrongly, effective work or rightful data can not be obtained, also the precision of finishing become uneven. In order to keep maintain stable track, suitable control work method and inspection method making use of machine and equipment must be established.

10.3.3 Track Maintenance Machines/Equipment

(1) Track Maintenance Machine

As stated in Chapter 3, Syrian Railways possess various large size maintenance machines, however, most of them are superannuated. The large size machine maintenance group of the Track and Structures Department of the Head office possess 2 Multiple Tie Tampers, 2 Ballast Profiling Machines and 2 Ballast Consolidating Machines which are fully functioning. Those 3 Machines in 1 set are executing track maintenance for sections for GESR.

Each one set should be assigned to North, East and Central Transport Bureau, to carry out overall tamping on all the sections of GESR once a year.

(2) Measuring Equipment and Appliance

Track inspection/measuring car now in use was introduced in 1982, but measuring items are limited and it takes time for data processing. Therefore, one (1) new one is planned to be introduced for improvement of track control.

For each track maintenance depot, one set of measuring equipments (level, transit, distance meter) will be assigned to have standard post to be placed.

Track Gauge or Level measuring appliances which are essentially needed at site are the appliances to be used so frequently, and therefore, it is needed to be maintained by checking and to keep ready for use. Those appliances which are not adjustable to use must be replaced.

10.3.4. Education and Training

Training Center is within Railway Academy, to make recruit education and rank-up training for staff who are to be engaged in field-work. Other than this, no particular Education/Training is now carried out. Along with the future increase of train operation and speed up operation, new technology for track maintenance will be introduced for maintaining safe track facilities.

To cope with such situations, appropriate education must be provided for staffs from organization concerned.

At present, there are many vacancies against full fixed strength staff in the head office as well as in the field organ. To cope with the increasing new lines, maintenance staff must be secured. Necessary condition of recruiting is different depending on working category. However, recruit is very difficult considering the current labor supply situations.

Considering the staffing situation of the entire state railway, it is thought that there may be some surplus staff in some railway fields and it is presumed possible to secure necessary staff after having transferring education and it is recommended to establish such transfer –education.

10.4 Staged Construction Plan of New Lines

To build up a network with neighboring countries, i.e., Iraq and Jordan and also to develop a domestic network, new line construction plans as shown in the followings are underway.

10.4.1 Deir el-Zor-Al Bukamal (N1)

This is a route originated from Deir el-Zor to Baghdad (Iraq) through the left side bank of the Euphrates River, and then crossing the river to the right side bank at midway to the border of Al-Bukamal. The project include a plan to construct a branch line linking with a natural gas exploitation site form an en-route station Al-Tabiye. As of now, approximately 22km of roadbeds from Deir el-Zor are completed. The outline of the plan is as follows:

Length of Main Track :	145.0km
Length of Station Track :	30.5km
Length of Branch Line :	14.0 km
Total Track Length :	189.0km
Stations :	6 stations (Al-Tabiya, Al-Mayadin, Ghranji, Al-Bahra, Al-Maslakha and Al-Bukamal)
Track Structure Standard :	2^{nd} grade line (per Russian Railway) Passenger train -160km/h, freight train -120km/h. Axle load - 25 tons Annual net tonnage : 15-25 million tons

10.4.2 Damascus – Darra (N2)

This is a route planned originating from Damascus along the Daraa line of Hedjaz Railway headed to the south via Darra to the border and reaches Amman (Jordan). The plan includes a branch line from an en-route station Sheikh Meskin to the east and reaching Sowaida. As of now, a little part of structures near Damascus is completed.

The outline of the plan is as follows:

Length of Main Track :	101.0km
Length of Station Track :	32.5km
Length of Branch Line :	51.0 km
Length of Station Track for Branch Line :	15.0 km
Total Track Length :	199.0km
Stations (Main Line) :	7 stations (Kiswa, Ghbagheb, Sanamein, Mahaja, Sheih Meskin, Dael and Darra)
Station(Branch Line) :	4 stations
Construction Cost:	7,353 million Syrian Pound
Track Structure Standard :	3rd Grade Line (per Russian Railway standard) Passenger train- 120km/h, freight train-100km/h. Axle load -25 tons Annual net tonnage : 8 to 15 million tons

10.4.3 Al-Sharqia – Deir el-Zor (N3)

This is the extention of the current Mihine～Sharqia line constructed to transport phosphate ores exploited near Sharqia to the Tartous port. By extending and connecting the line to Deir el-Zor, this line becomes a shortcut from Qamishli and Deir el-Zor to Tartous and Damascus.

Since there are the Parmyla remains, which are one of the world heritages near Sharqia, this route would have a high potential in the future for tourist traffic. Partially from Sharqia to Tadmor, 3 stations with a track length of about 44.6km are under construction, however, not even a survey has yet commenced for the section between Tadmor and Dei el-Zor, the route length of which is about 194 km.

10.4.4 Others

Besides the above-mentioned 3 line sections, other new line constructions are planned for sections where domestic railway network is not enough. Also, to link developing industrial complex along the line to the nearest station, freight exclusive line is to be constructed. Further study is necessary to identify the details of the need of construction. Table 10.4.1 shows these plans and their approximate length.

Table 10.4.1 Table of New Line Plan

No.	Section	Category	Length (km)	Remarks
N4	Adra – Kabon	New Line	23	
N5	Marret Ikhwan – Edlab	New Line	31	
N6	Akkari – Lebanon Border	Reconstruction	5	
N7	Kadam – Hejaz Station	New Line	4	
N8	West Entrance to Aleppo (＊)	Relocation	28	
S1	Muslimia – Industrial Zone	Construction to Industrial Zone	4	
S2	Adra – Industrial Zone	- ditto -	3	
S3	Noamis – Industrial Zone	- ditto -	17	
S4	Jisr Elshogour for Suger Beat Factory	- ditto -		
S5	Tel Alo – Al Rumilan for Croude Oil & Natural Gas	- ditto -		
S6	Hassaka – Shddadah for Crude Oil & Natural Gas	- ditto -		

(＊) There is a future plan to make Aleppo station as passenger-exclusive station.

10.4.5 Staged Construction Plan

(1) Schedule

New line construction already commenced by GESR will be kept advanced. And, as for construction of other new lines of which construction will be commenced from now, it should be synchronized with the commencement of commercial operation of traffic. Entire construction plan and route length, number of station are shown in Table 10.4.2.

Table 10.4.2 Construction Schedule of New Line

No.	Line Name	Schdule 2000 2005 2010 2015 2020	Railway Length (km)	Station (place)	Remarks
N1	Deir el-Zor - Al-Bukamal		**145.0**	**6**	
N2	Damascus - Daraa		**152.0**	**7**	
N3	Al Sharqia - Deir el-Zor		**239.0**	**14 (9)**	
N4	Adra - Kabon		**23.0**	**3**	
N5	Marret Ikhwan - Edlab		**31.0**		
N6	Akkari - Lebanon Border		**5.0**		
N7	Kadam - Hidjaz Station		**4.0**	**1**	
N8	West Entrance to Aleppo		**28.0**	**1**	
	Total		**627.0**	**32**	

Note : The figure in ( ) indicates GESR Plan.

(2) Construction Cost

Itemized construction cost and schedule by lines are shown in Table 10.4.3.

Table 10.4.3 Construction Cost of New Line

Unit : Million SP

Line	Item	2001-2005	2006-2010	2011-2015	2016-2020	Total
N1 Deir el-Zor-Al Bukamal	Land	**518**	**0**	**0**	**0**	**518**
	Roadbed	**5,466**	**0**	**0**	**0**	**5,466**
	Track	**3,441**	**0**	**0**	**0**	**3,441**
	Total	**9,425**	**0**	**0**	**0**	**9,425**
N2 Damascus-Daraa	Land	**593**	**0**	**0**	**71**	**664**
	Roadbed	**6,258**	**0**	**0**	**674**	**6,932**
	Track	**3,939**	**0**	**0**	**503**	**4,442**
	Total	**10,790**	**0**	**0**	**1,248**	**12,038**
N3 AlSharqia-Deir-el-Zor	Land	**542**	**320**	**0**	**0**	**862**
	Roadbed	**4,840**	**4,305**	**0**	**0**	**9,145**
	Track	**2,378**	**3,678**	**0**	**0**	**6,056**
	Total	**7,760**	**8,303**	**0**	**0**	**16,063**
N4 Adra-Kabon	Land	**108**	**0**	**0**	**0**	**108**
	Roadbed	**1,134**	**0**	**0**	**0**	**1,134**
	Track	**713**	**0**	**0**	**0**	**713**
	Total	**1,955**	**0**	**0**	**0**	**1,955**
N5 Marret Ikhwan-Edlab	Land	**0**	**0**	**111**	**0**	**111**
	Roadbed	**0**	**0**	**1,169**	**0**	**1,169**
	Track	**0**	**0**	**735**	**0**	**735**
	Total	**0**	**0**	**2,015**	**0**	**2,015**
N6 Akkari-Lebanon Border	Land	**0**	**0**	**0**	**0**	**0**
	Roadbed		**0**	**0**	**0**	**0**
	Track	**110**	**0**	**0**	**0**	**110**
	Total	**110**	**0**	**0**	**0**	**110**
N7 Kadam-Hidjaz Station	Land	**135**	**25**	**0**	**0**	**160**
	Roadbed	**168**	**108**	**0**	**0**	**276**
	Track	**0**	**84**	**0**	**0**	**84**
	Total	**303**	**217**	**0**	**0**	**520**
N8 West Entrance to Aleppo	Land	**0**	**112**	**0**	**0**	**112**
	Roadbed	**0**	**1,121**	**0**	**0**	**1,121**
	Track	**0**	**926**	**0**	**0**	**926**
	Total	**0**	**2,159**	**0**	**0**	**2,159**
Ground Total		**30,343**	**10,679**	**2,015**	**1,248**	**44,285**

Chapter11 Improvement of Signal and Telecommunication Systems

11.1 Basic Policy

Signal and telecommunication facilities can be largely classified into three categories：(1) Lattakia – Aleppo – Qamishli (about 739km) sections were constructed around in 1971 with signal and telecommunication equipment of Type1; (2) Tartous – Homs 2 (about 102km) , Aleppo – Damascus (about 382km) and Mhine – Al-Sharqia (about 110km) sections were constructed around in 1982 with equipment of Type 2 ; (3) In the sections of Aleppo – Midan Ekbas (about 117km), Qamishli – Al Yaroubiye (about 80km) and Lattakia – Tartous (about 86km), there is no particular signal and telecommunication equipment except radio equipment installed around in 1993 and decrepit bare wire lines.

Equipment and devices of signal and telecommunication to be installed in this plan are based on internationally recognized standards and well proven technologies .
They should be also selected carefully considering maintainability from various points.

In the installation of telecommunication cables and transmission system, there should be considered the increase of computer terminals and communication lines due to the expansion of information systems in the GESR such as freight information system, ticket reservation and vending system and other management system in the future.

Centralized supervising system of equipment and devices should be introduced to detect function deterioration and failures of signal and telecommunication equipment and to decrease chances of the equipment failures and the time of recovery.

11.2 Improvement Plan of Signal Equipment and Devices

11.2.1 Blocking Equipment

(1) Double track section

The indication of the signal is to be automatically controlled by the track circuits, which are installed continuously both in the station area and in the section between stations.

A number of signals are to be provided between stations to divide the section into small block sections.

(2) Single track section

In the station area, continuous track circuits are to be provided, whereas in the section between adjacent stations, short track circuits (CT, OT) are to be installed only at the home signals to detect train going/coming.

11.2.2 Signals

The planned speed of trains is to increase due to improvement of the track, level crossing, rolling stock, and others.
Accordingly, necessary visible distance of signal indication should be longer than the present one.
It is also necessary to examine introduction of color light signal of LED (Light Emitting Diode) with long life.

In the single track sections, Distant signal is to be installed at the outside of the home signal for the purpose of repeating signal aspect in the same way as the current system.

11.2.3 Interlocking devices

The electronic interlocking devices (computerized interlocking systems) are to be used for all stations with turnouts.
In this master plan, the electronic interlocking device is to be installed in each station. However, thanks to the installation of optical fiber cable, concentrated installation of interlocking devices of several stations into one place becomes possible.

11.2.4 Level crossing protection devices

Level crossing protection devices are to be installed at the level crossings with no signal protection devices at present, after considering volume of road traffic, volume of railway traffic and the distance of unobstructed view from the road.
In addition to the crossing alarm and crossing gate, warning devices to the trains are to be provided to inform the obstacle to the train drivers by using manipulator at the level crossing.
The electronic level crossing protection devices, which are gradually introduced, will be used after comparison of reliability, maintenance method, and the construction cost between the electronic type and the magnetic relay type.

11.2.5 ATS/ATP (Automatic Train Stop/Automatic Train Protection)

ATS/ATP system is to be used in all the section lines of the GESR.
ATS/ATP system is to be used to stop a train automatically before it runs into the section indicating red signal because of oversight.
Also ATS/ATP system is to be used to reduce a train speed to a regulated speed at the place like switches, curved sections and sections under construction.

11.2.6 CTC (Centralized Train Control)

CTC system, in which the switches and signals of the remote stations are watched and controlled from the CTC center directly, is to be installed to control and supervise efficiently train operation of the section.
The five CTC centers (Aleppo, Lattakia, Homs, Damascus, Deir el-Zor) are to be constructed in this master plan.
Fig 11.2.1 shows these five CTC centers and stations controlled from each CTC center.
These five CTC centers are to be supervised from the master control center in Aleppo.

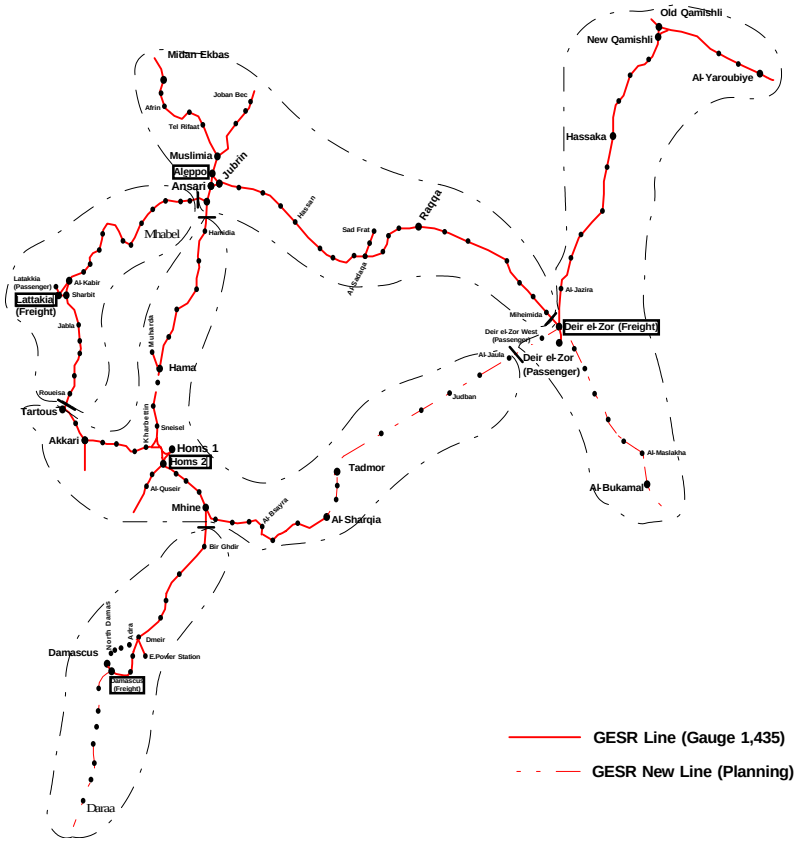

Fig 11.2.1 CTC center and Control Section

11.2.7 Centralized monitoring device

The centralized monitoring devices are to be provided in this master plan.
The centralized monitoring device is to detect and inform the deterioration of various signal and telecommunication equipment along the railway lines, or to detect failures of equipment and to inform it to the CTC center/maintenance depot to repair.

11.3 Improvement plan of telecommunication equipment and devices

11.3.1 Telecommunication cable

Complex optical fiber cables or optical fiber cable and metallic cable are to be installed under ground along all sections.
Metallic lines in the cable are to be used for lines of the telephone box, lines of the centralized monitoring devices, lines of devices for detecting such disaster as falling rocks and sand pile.
Fiber cores are to be used for the train operation, management of personnel, maintenance of facilities and other basic communication network for the GESR.

11.3.2 Fiber optic transmission system

STM-1 (155.52Mbps), interface name of SDH (Synchronous Digital Hierarchy), is to be used for the fiber optic transmission system in GESR.

11.3.3 Digital exchanger

Telephone network of the GESR is to be systematized by one numbering plan.
Digital telephone exchangers are to be installed in twelve stations.

11.3.4 Radio communication

Radio communication link between the train driver and stationmaster in the station area (dispatching radio communication line) is to be extended to the CTC center.
Radio frequencies which are used for the radio link between adjacent stations at present are to be utilized for the communications between maintenance employee (track, signal and telecommunication) working alongside the track and relevant station/depot, or to be used in the case of accident. (train drivers could carry this radio telephone set throughout their duty)
Radio communication link used in the station yard at present is to be continued.

11.4 Maintenance organization

11.4.1 Basic idea of maintenance

Inspection of equipment is to be conducted at regular intervals and to get necessary data.
Such data as installation date, inspection date and data, date of failure, kind of failure and repaired result are to be accumulated for equipment by equipment.
These data are to be utilized for later inspection and restoration of later failure.
Equipment failure records are to be concentrated and major failure records are to be displayed in the CTC center for the quick restoration, and these concentrated failure and deterioration records are to be displayed or to be monitored by using terminals at the maintenance depot in charge.

11.4.2 Maintenance employees

Number of maintenance employees of the signal and telecommunication equipment and devices are to be increased, because new signal stations and level crossings with signal protection devices will be introduced for improvement of the sections.
Number of maintenance employees is to be 615 by 2020 as shown in the Table 11.4.1.
Except engineers in the head office, these maintenance employees are to be stationed in the depot shown in the Fig 11.4.1.
Maintenance staff is to be collectively positioned so that they can be dispatched to any site in trouble within at least one hour from a depot in charge.
In general, maintenance is conducted centering on equipment inspection by the experts of respective field pooled in the depot concerned.
Maintenance engineers are to be stationed at depot so as someone in the depot can make restoration of any equipment in trouble.

Table 11.4.1 Number of Employees

	at present (2000)	I stage 2001～2005	II stage 2006～2010	IIIstage 2011～2015	IVstage 2016～2020
Number of increase					
Rehabilitation		23	23	2	0
New section		39	30	32	17
Number of increase(total)		62	53	34	17
Total Number of maintenance employee	450	512	565	598	615

* New section: including new signal station and double track

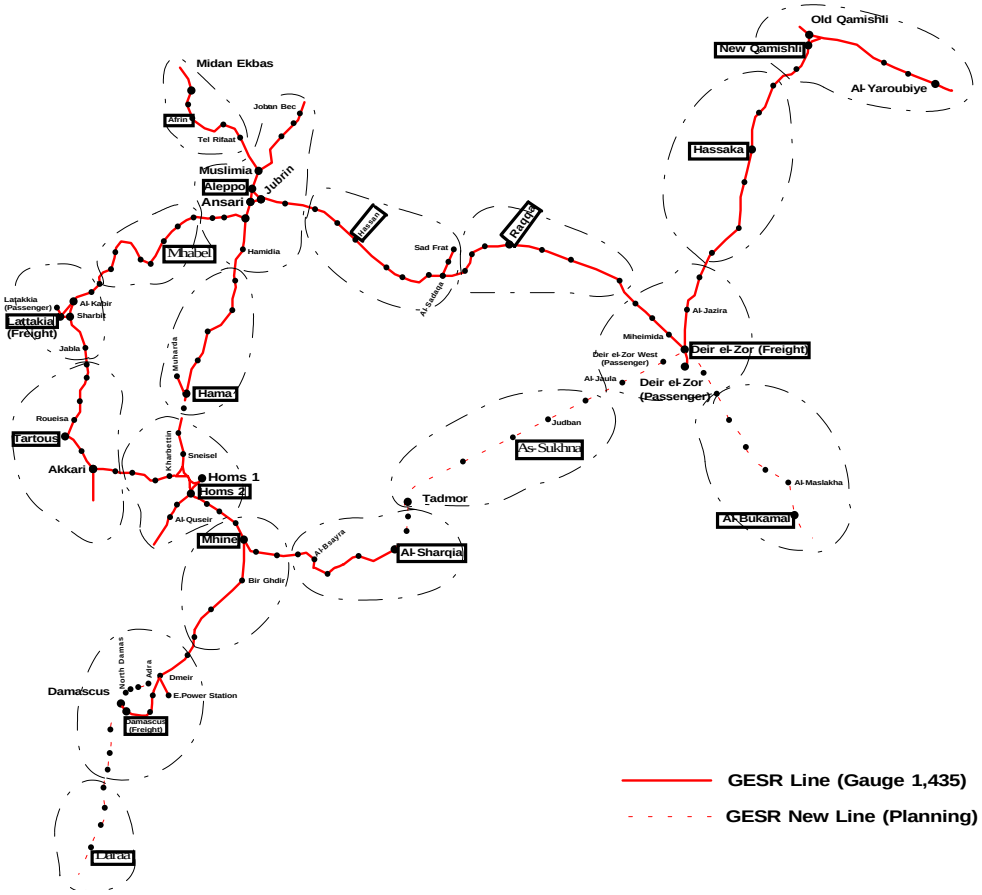

Fig 11.4.1 maintenance depot and its covering area

11.5 Staged construction plan for signal and telecommunication equipment

Table 11.5.1 shows construction time, construction number of major equipment and construction cost of signal and telecommunication equipment and devices.

Table 11.5.1 Staged Construction Plan for Signal and Telecommunication (Including construction expense)

Project	No of station length(km)	Signal & Telecommuni- cation at present	I stage 2001～2005	II stage 2006～2010	III stage 2011～2015	IV stage 2016～2020	Summary of Construction
Midan Ekbas～(Aleppo)	8	no signal equipment		———			(T)143,(S)169,(SW)90,(LCA)14,(LCG)3,(cable,20kvline)120k,
	117	OHL(4)		616			(L)IP/SI(STM)(Radio)(CTC)(cable of st.)8
(Aleppo)～Damascus	23	Type2		———	·····	·····	(T)502,(S)468,(SW)289,(LCA)50,(LCG)23,(cable,20kvline)894k,
Aleppo,Ansari,Wudehi are not included	395	cable(7Q1.4mm)		1833	339(8st,54k)	225(5st,46k)	(L)IP/SI(STM)(Radio)(CTC)(cable of st.)23,(PA)3,(PBX)3
Aleppo～Lattakia	13	Type1	———	·····		·····	(T)167,(S)253,(SW)183,(LCA)26,(LCG)10,(cable,20kvline)208k,
	194	OHL(8)	892	17(15k)		103(3st)	(L)IP/SI(STM)(Radio)(CTC)(cable of st.)13,(PA)2,(PBX)2
(Lattakia)～(Tartous)	5	no signal equipment	———				(T)149,(S)144,(SW)97,(LCA)27,(LCG)7,(183,(cable,20kvline)96k
	89	no wire line	472				(L)IP/SI(STM)(Radio)(CTC)(cable of st.)6
Tartous～(Homs～Mhine)～Al Sharqia	15	Type2	———	·····	·····	·····	(T)312,(S)326,(SW)193,(LCA)32,(LCG)15,(cable,20kvline)211k,
	216	cable(7Q1.4mm)		1189(2st,79k)	88(1st,49k)	69(2st)	(L)IP/SI(STM)(Radio)(CTC)(cable of st.)15,(PA)1,(PBX)1
(Aleppo)～Deir el-zor	20	Type1	———		·····	·····	(T)322,(S)293,(SW)195,(LCA)34,(LCG)6,(cable,20kvline)347k,
	323	OHL(8)	1283		70(2st)	307(9st)	(L)IP/SI(STM)(Radio)(CTC)(cable of st.)20,(PA)2,(PBX)3
(Deir el-zor)～Qamishli	7	Type1	———			·····	(T)96,(S)88,(SW)78,(LCA)8,(LCG)6,(cable,20kvline)216k,
	211	OHL(8)	531			139(4st)	(L)IP/SI(STM)(Radio)(CTC)(cable of st.)7,(PA)2,(PBX)2
(Qamishli)～Al Yaroubiye	3	no signal equipment			———		(T)34,(S)43,(SW)24,(LCA)3,(LCG)1,(cable,20kvline)78k
	76	no wire line			209		(L)IP/SI(STM)(Radio)(CTC)(cable of st.)3
(Deir el-zor)～Al Bukamal	6		———				(T)128,(S)128,(SW)96,(LCA)10,(LCG)3,(cable,20kvline)147k
	140		483				(L)IP/SI(STM)(Radio)(CTC)(cable of st.)6
(Damascus)～Kiswa～Jordan Border	7		———		———		(T)144,(S)144,(SW)96,(LCA)10,(LCG)7,(cable,20kvline)103k
	97		72(1ST)		408(6ST)		(L)IP/SI(STM)(Radio)(CTC)(cable of st.)7
(Al Sharqia)～Tadmor～Deir el-zor	8			———	·····	·····	(T)88,(S)64,(SW)48,(LCA)16,(LCG)13,(cable,20kvline)234k
	238			549	35(1st)	171(5st)	(L)IP/SI(STM)(Radio)(CTC)(cable of st.)8
Adra～Kabon	4		———				(T)64,(S)64,(SW)96,(LCA)4,(LCG)3,(cable,20kvline)24k
	24		241				(L)IP/SI(STM)(Radio)(CTC)(cable of st.)4
(Maarret Ikhwan)～Edlab	1				———		(T)20,(S)20,(SW)16,(LCA)0,(LCG)0,(cable,20kvline)31k
	31				80		(L)IP/SI(STM)(Radio)(CTC)(cable of st.)1
(Akkari)～Lebanon Border	1		———				(T)20,(S)20,(SW)16,(LCA)0,(LCG)0,(cable,20kvline)5k
	5		66				(L)IP/SI(STM)(Radio)(CTC)(cable of st.)1
(Kadam)～Hidjaz station	1		———				(T)20,(S)20,(SW)16,(LCA)0,(LCG)0,(cable,20kvline)4k
	4		67				(L)IP/SI(STM)(Radio)(CTC)(cable of st.)1
West Entrance to Aleppo	2			———			(T)20,(S)20,(SW)16,(LCA)0,(LCG)0,(cable,20kvline)14k
	14			94			(L)IP/SI(STM)(Radio)(CTC)(cable of st.)2
Freight Information System	35				———		35terminals
					189		
Total			4107	4308	1406	1013	

(million sp)

——— rehabilitation
····· grade-up
( ) st:signal station
k :length of double track

(T)track circuit,(S)colour light signal,(SW)switch machin,
(LCA)crossing alarm,(LCG)crossing gate,(cable)fiber cable,
(PBX)pabx
(L)interlocking device,(P/S)power supply(STM)opt. Terminal
(Radio)radio base,(CTC)ctc unit(cable of st.)cable in station
and others

Chapter 12 Administration, Operation and Training Plan

12.1 Organization and Number of Personnel

12.1.1 Organization

GESR is controlled under the administration consisting of the Director General, the Deputy-Director General and two committees (Executive Committee and Business Committee). The organization of GESR consists of 17 Divisions in Headquarters and three Regional offices (Eastern, Central and Northern). The organization of GESR may be kept as it is on the whole.

The railway labor union of Syria is cooperative to the enterprise. Some of the union leaders take part in administration and management as members of the above-mentioned committees. In implementing modernization and improvement of GESR, cooperation from the labor union can be expected. The number of employees in GESR seems to be excessive compared with railways in developed nations. Each section or division has no strong intention to cut the number of personnel.

12.1.2 Number of Personnel

(1) Car Inspection Workshops and Depots

Diesel cars are to be maintained and inspected at the locomotive workshop and daily inspection and small repair are to be handled by passenger coach depots.

(2) Station Personnel and Train Crew

The personnel plan for the coming 20 years have been drawn up upon the following conditions.

a) Assistant drivers are no more required to be on duty.
b) Train operation handling at stations is abolished by introducing CTC system.
c) Chief conductors of freight trains are not necessary because locomotive drivers can handle their duty instead.

(3) Personnel for Track Maintenance

Number of track maintenance personnel per 1 km of route length at present is too many

compared with JR Group Companies in Japan. This is particularly remarkable in the number of middle and superior officers. The present number of personnel will be enough for the maintenance of the whole extended tracks by 2020 by modernization of maintenance technology, utilization of new equipment for maintenance and introduction of outsourcing system of maintenance work.

(4) Personnel in Electrical Sector

As the results of replacement and improvement of signal and telecommunication equipment, number of personnel in electrical sector is assumed to increase.

12.2 Personnel Plan

Table 12.2.1 shows the plan of total employees including personnel in Headquarters. The number of personnel in Headquarters is assumed to be at the same level as at present. In 2005 and 2010 it is possible to handle increased volume of transport by less personnel than those working at present. As it is not permitted by laws in Syria to dismiss the surplus employees, they should be absorbed as follows.

(1) Conversion to Another Section after Training for New Type of Job
(2) Decrease of Personnel by Voluntary Resignation
(3) Transfer to the Related Business

Table 12.2.1 Personnel Plan of Total Employees

	at Present	2005	2010	2015	2020
Total Number of Employees	10,778	10,011	10,589	11,842	13,224

12.3 Administration and Operating Cost

Administration and Operating Cost (excluding depreciation) consist of personnel and material costs and appropriate base unit is set for each item. In this analysis material costs are further divided into the following three expense items.

(1) Lubricant & Fuel
(2) Maintenance Expenses
(3) Other Operating Cost

To find suitable base units, financial statements of GESR for the past three years have been analyzed. Personnel expense per person is set as base unit for estimating Personnel Cost. Lubricant & Fuel and Maintenance Expenses per Car KM is set as base unit for estimating these expenses, and Other Operating Costs per Transport Volume (Passenger Ton km) is set at base unit for estimation of Other Operating Costs. The results of the analysis show that base unit for each expense item is almost constant for these three years. Therefore the following base units are used for calculation of Administration and Operating Cost in financial analysis (Table 12.3.1)

Table 12.3.1 Analysis of Administration and Operating Costs of GESR

(Unit: Syrian Pounds)

Expense Item	Base Unit	
Personnel Cost	84,500 ／person	(Number of Employees)
Lubricant & Fuel	3.65 ／km	(Car km)
Maintenance Expenses	2.70 ／km	(Car km)
Other Operating Costs	0.053 ／passenger.ton.km	(Transport Volume)

No adjustment for price hike is made between 1999 and 2001, because the latest available data show that the commodity price of Syria is stable for the past several years with some seasonal fluctuation Base units except for personnel cost are assumed to go down gradually by equal difference to 70% in 2005 taking the effects of improvement and rationalization into consideration.

12.4 Education and Training

(1) Concept for Improvements

Middle Technical Institute of Railway and Training Center located in Aleppo are GESR's educational institutions, both of which are well equipped with facilities required for specific education and training. A competent division of GESR is involved and satisfactory results have been achieved.

In order that GESR is developed as a modernized railway, education and training of their employees are indispensable; therefore further improvement will be required. In particular, safety-oriented education as the basis in the transport business and a higher level of fundamental engineering that supports the former is essential.

(2) Overseas Training and dispatching of Engineers Abroad

To cope with ever-increasing high technology, overseas training intended for staff members of a leader level would be an effective step.

Also, training conducted by the country where new materials procurement and or dispatching trainee is very effective.

(3) Enforcement of Conversion Education

In line with the advancement of transport improvement, unevenness of staff will occur depending on the type of job occupancy. Therefore, in order to make smooth execution of conversion training upon providing mitigation of examination qualification.

(4) Introduction of Correspondence Course

A correspondence course is available as a. supplementary educational means to the Training Center. GESR has to bear a certain cost such as provision of teaching materials, its distribution, and evaluation of test results, etc., trainees will receive a benefit to extend their job knowledge, and eventually they could achieve certain qualifications.

(5) On-the-job Training

By carrying out organized on-the-job training and technology improvement, coordination among the concerned staff can be achieved.

(6) Provision of Customer Service Program

Sales sector, in, particular, employees working at ticket barriers, those at ticket window and conductors aboard train who are to deal with customers directly, should receive a practical job knowledge, a customer service program there for should be added to the curriculum.

When passengers have an opportunity to use GESR, ticket window at stations is the first meeting point. Therefore, if the service by staff were satisfactory, it would lead to a better image of the railway.

(7) Consciousness Education

In order to have common intentional consciousness over the entire organization of GESR, consciousness education should be enforced by the specialist.

Chapter 13 Business Improvement Plan

13.1 Concept for Business Improvement

(1) Outlook of Business for year of 2020

According to the demand forecast as described in Chapter 7, the business scale in the year 2020, The increase in passenger sales will be 6.26 to 11.06 times, while the increase in freight sales is expected to be 6.92 to 8.32 times over the year 1999.

(2) Direction of Business improvement

It is necessary for GESR to make investments aggressively for the improvement of various railway fixed facilities and increasing rolling stock, in order to secure safety and punctuality of train operations. At the same time it is necessary to improve the following business aspects.

1) Changeover of Sales Posture

In view of current Sales business, a negative posture due to constant unreliable traffic status can be observed. Especially in the Passenger Sales, little advertisement is made because only a few trains are running at present. On the other hand however, there is an active move as seen in the new transport service to Iraq, therefore, it would be possible to attract customers through the development of new services. Ii is a prerequisite that reliable train operations are guaranteed by way of necessary investments in new facilities and improvement of transport service.

2) Establishment of Sales Control System

In order to perform appropriate sales control precisely, a management system should be established, and at the same time, daily administrative data as indicated below should be orderly compiled and filed.

3) Modernization of Sales Information Management

As an information management system in the GESR, computers have been partially introduced; however, on-line data processing is not performed. In the future where the transport volume is expanded, computer terminals should be provided at each station

and field sites to control the data in various fields comprehensively on on-line basis. In this connection, the following should be promoted.

① Seat Reservation System

The above system is required to cope with future increase in trains having reserved seats.

② Freight Information System

For automatic issuing of freight invoice and data processing for traffic information.

13.2 Improvement to Passenger Business

(1) Strategy for Improvements to Passenger Business

1) Change over the past negative sales posture, develop sales activities for expansion of service.

2) Improve tariff, institution system to accord with customer's needs along with the increase of transport capacity.

3) To improve sales system for enabling railways to favorably compete with bus transport.

(2) Establishment of Sales Posture

1) Announcement of Train Time-Table and Information of journey

Bring up the image of GESR

2) Improvement of Environment

① station facilities convenience and comfortable environment

② coach improvement of facilities (toilet etc)

(3) Improvement of Passenger Fare and the System

1) Passenger

When the railway will be improved and reach a stage judged appropriately compatible with other transport means upon having investment and transport improvement, it is

necessary to enforce the fare increase to meet the cost.

2) Dividing Base Fare and Service Charges

Passenger fares are classified into the base fare for a travel from a departure point to an arrival point and 'various service charges attributed to added values for express, reserved seat, and sleeping car.

The fare system adopted by GESR includes base fare and all related service charges combined. When train frequency will be increased and passengers will select multiple different classes of trains or miscellaneous service charges, the base fares and service charges must be divided.

3) Issuing of Various Types of Tickets

When train frequency increased and users' needs diversified, various kinds of tickets, such as a round-trip tickets, will have to be issued to meet their needs.

(4) Development of Sightseeing tour and Promotion of Railway trips

Dynamic sales activities are recommended by operating sightseeing trains connecting with such sites.

Also, by setting up package tours in association with bus/hotel business would be an asset in the future.

(5) Connecting Service with Bus Operators

In the future when more trains run reliably, connection with bus transport. as a feeder service at major stations would be required.

In that instance, it is desirable that close coordination be made between each party so that appropriate train diagrams could be prepared considering the bus connecting time for users convenience.

13.3 Improvement to freight Business

(1) Strategy for Freight Business Improvements

1) To maintain reliable transport service, regular train schedules must be established complying with traffic volume of each line, and in order to reduce transport time and

to make clear arrival dates, designated connecting freight transport system should be promoted.

2) Strategic freight stations should be well developed and up-dated transport service such as container system should be promoted..

3) Expanding the use of exclusive sidings, promotion of consignor wagon ownership; preparation of standardized contract form should be promoted.

4) Facilities and equipment for loading/unloading at freight stations should be updated to cope with connection with truck transport.

(2) Improvement to Transport System

The current system by which a train is selected from a pre-arranged diagram for operations may be effective in terms of hauling efficiency of a train, however, it has caused a considerable train delay. This is a major cause of making stagnant the transport of general cargo. To implement freight traffic as scheduled, stable traffic capacity must be secured and regular train schedules are required. Further, if transport time is reduced and consignees were informed of freight arrival dates clearly by the means that the shipment was made with a designated connecting freight transport system, it would be an effective means to attract more customers, Also, if a regular train operation plan was prepared at least on the monthly basis, assignments of locomotive and train crew would be adequately planned.

(3) Modernization of Transport System

System change to Container transport

(4) Promotion of Sales Policy

1) Promotion of Exclusive Sidings

The exclusive siding for Phosphorus Ore Public Corporation is a very important facility that is closely connected to the railway.

2) Promotion of Consignor Wagon owning system

As an effective means to increase wagons in the future, this system should be

aggressively incorporated. As a target, in addition to fuel tank wagon, cereal hopper wagon and etc. should be considered for this system.

3) Conclusion of comprehensive contract (discounted rate)

Comprehensive contract will conclude an agreement defining a certain fixed period for transport, minimum shipping tonnage, freight charge (discounted rate), and supplemental conditions.

Shipping as originally planned can be guaranteed to consignors while GESR could receive a benefit in securing a certain traffic volume and effective use of transport capacity.

(5) Rate and the System

When the numbers of kinds of freight goods become increased very much some aspects of rate grading system of goods may not comply with the practical situations. It may be recommendable to study on abolition of rate grading system.

(6) Modernization of Freight Handling Facilities

Provision of freight depot and introduction of the work with forklifts

13.4 Freight information System

Freight invoices are issued at each computer terminals. Transport and Sales information should be incorporated by on-line system.

(1) Business control information

By issuing freight invoice, grasp various data necessary to control business and accord with consignor service in quick.

(2) Transport control information

By the information of freight car allocation, train forming station and train control, transport effectiveness can be obtained.

Chapter 14 Investment Planning in Staged Development Plan

14.1 Preconditions for Calculating the Amount of Investment

In principle, the amount of investment is calculated on the basis of the following preconditions.

(1) In calculating the amount of investment, the price as of June 2000 is applied, and factors related to future escalation are not considered.

(2) The currency conversion rate is :

US$ 1 =¥106 = SP 46, as of June 2000.

(3) The amount of investment is divided into the local currency portion and the foreign currency portion, and both are calculated in SP.

(4) As for the improvement and construction cost, the labor cost and material cost(including machine depreciation) are calculated for each construction work item.

(5) The labor cost is calculated in the local currency for each construction work item.

(6) In calculating the labor cost, material cost and so forth, the unit prices for each kind of work are based on the data supplied by the Syrian side. As for the unit prices for works which have not been conducted in Syria so far, new prices are established suitably by taking into consideration the actual results of construction works in Japan.

(7) As for the imported materials (including rolling stock) and so forth calculated in foreign currencies, CIF prices are applied by taking into consideration the actual results in the GESR.

(8) As the engineering fee, 5% of the improvement and construction cost is earmarked.

14.2 Investment Planning in the Staged Development Plan

The amount of investment by item of improvement and construction is as shown in Table 14.1.

The amount of investment for each project in the staged development plan excluding the engineering fee is as shown in Table 14.2.

Table 14.1 Investment Cost

Unit : million Sp

Item	Foreign Currency	Local Currency	Total	%
Rehabilitation, Modernization of Existing Line	23,028	18,769	41,797	24.4
New Line Construction	12,767	33,749	46,516	27.1
Workshop Improvement	14,250	5,350	19,600	11.4
Freight Information System	188	1	189	0.1
Sub Total	50,233	57,869	108,102	63.0
Rolling Stock	52,154	5,805	57,959	33.8
Engineering Fee (SubTotal * 5%)	2,512	2,893	5,405	3.2
Sub Total	54,666	8,698	63,364	37.0
Ground Total	104,899	66,567	171,466	100.0

Table 14.2 Schedule of Investment

Unit : Million SP

	Descriptions	Item	2001-2005	2006-2010	2011-2015	2016-2020	Total
Rehabilitation of Railways							
1	Midan Ekbas-Aleppo	Track & Structure	4,402	3,988	0	0	8,390
		Signal & Telecom	0	616	0	0	616
		Total	4,402	4,604	0	0	9,006
2	Aleppo-Damascus	Track & Structure	1,900	2,774	2,207	1,657	8,538
		Signal & Telecom	0	1,833	333	225	2,391
		Total	1,900	4,607	2,540	1,882	10,929
3	Aleppo-Lattakia	Track & Structure	941	0	0	0	941
		Signal & Telecom	892	17	0	103	1,012
		Total	1,833	17	0	103	1,953
4	Lattakia-Tartous	Track & Structure	422	0	0	0	422
		Signal & Telecom	472	0	0	0	472
		Total	894	0	0	0	894
5	Taltous-Homs	Track & Structure	922	2,869	3,156	176	7,123
		Signal & Telecom	0	674	48	69	791
		Total	922	3,543	3,204	245	7,914
6	Aleppo-Deir el-Zor	Track & Structure	1,632	0	176	528	2,336
		Signal & Telecom	1,283	0	70	307	1,660
		Total	2,915	0	246	835	3,996
7	Deir el-Zor-Qamishli	Track & Structure	998	0	410	410	1,818
		Signal & Telecom	531	0	0	138	669
		Total	1,529	0	410	548	2,487
8	Qamishli-Al-Yaroubiye	Track & Structure	0	0	825	835	1,660
		Signal & Telecom	0	0	203	0	203
		Total	0	0	1,028	835	1,863
9	Mihine-Al -Sharqia	Track & Structure	531	1,536	88	0	2,155
		Signal & Telecom	0	525	40	0	565
		Total	531	2,061	128	0	2,720
Sub Total			14,926	14,832	7,556	4,448	41,762
Construction of New Line							
1	Deir el-Zor-Al Bukamal	Track & Structure	9,425	0	0	0	9,425
		Signal & Telecom	483	0	0	0	483
		Total	9,908	0	0	0	9,908
2	Damascus-Jordan BorderDaraa	Track & Structure	10,790	0	0	1,248	12,038
		Signal & Telecom	72	0	408	0	480
		Total	10,862	0	408	1,248	12,518
3	AlSharqia-Deir-el-Zor	Track & Structure	7,760	8,303	0	0	16,063
		Signal & Telecom	0	549	35	171	755
		Total	7,760	8,852	35	171	16,818
4	Adra-Kabon	Track & Structure	1,955	0	0	0	1,955
		Signal & Telecom	241	0	0	0	241
		Total	2,196	0	0	0	2,196
5	Marret Ikhwan-Edlab	Track & Structure	0	0	2,015	0	2,015
		Signal & Telecom	0	0	80	0	80
		Total	0	0	2,095	0	2,095
6	Akkari-Lebanon Border	Track & Structure	110	0	0	0	110
		Signal & Telecom	66	0	0	0	66
		Total	176	0	0	0	176
7	Kadam-Hidjaz Station	Track & Structure	303	217	0	0	520
		Signal & Telecom	67	0	0	0	67
		Total	370	217	0	0	587
8	West Entrance to Aleppo	Track & Structure	0	2,159	0	0	2,159
		Signal & Telecom	0	94	0	0	94
		Total	0	2,253	0	0	2,253
Sub Total			31,272	11,322	2,538	1,419	46,551
Workshop (Including Depot)							
	Jubrin Loco. Workshop	Building	7,800	0	0	0	7,800
		Machine	1,250	0	0	0	1,250
		Total	9,050	0	0	0	9,050
	Aleppo F.C. Workshop	Building	3,000	0	0	0	3,000
		Machine	600	0	0	0	600
		Total	3,600	0	0	0	3,600
	Jubrin F.C. Worshop	Building	0	2,150	4,000	0	6,150
		Machine	0	200	600	0	800
		Total	0	2,350	4,600	0	6,950
Sub Total			12,650	2,350	4,600	0	19,600
Rolling Stock							
	Locomotive & Diesel Car		5,362	4,416	13,150	13,900	36,828
	Freight Wagon & Passenger Coach		365	3,446	7,635	9,685	21,131
		Total	5,727	7,862	20,785	23,585	57,959
Freight Information System							
	Electoronic				189		189
		Total			189		189
Ground Total			64,575	36,366	35,668	29,452	166,061

Chapter 15 Economic and Financial Evaluation

15.1 Econmic Evaluation

15.1.1 Rail Operating Unit Cost (ROUC), Vehicle Operating Unit Cost (VOUC) and Travel Time Unit Cost (TTUC)

The train operating between Damascus and Aleppo is chosen as the representative train for passenger transport and the train transporting phosphate from Al-Sharqia to Tartous as the representative train for freight transport.

The representative passenger train for the Do Nothing case is composed of one locomotive and 8 cars, while that for the Master Plan case is composed of five (5) diesel cars. The representative freight train is composed of one locomotive and 16 wagons. Locomotive type for the Do Nothing Case is LDE2800 traction and that of the Master Plan Case is LDE3200 traction.

Table 15.1.1 Summary of ROUC (Train)

Items/Type of the Train	Representative Passenger Train		Representative Freight Train	
	Present	M/P	Present	M/P
ROUC subject to Distance (SP/train km)	104.11	79.08	138.79	140.41
ROUC subject to Time (SP/train hr)	9,353.28	4,720.76	2,736.06	2,485.03

The representative vehicle types were selected based on the roadside traffic survey data and the vehicle operating unit costs (VOUC) were calculated as summarized in Table 15.1.2. Table 15.1.3 shows a summary of the travel time unit costs (TTUC) while Table 15.1.4 shows the freight time unit costs for the 32 commodity types adopted in this Study.

Table 15.1.2 Summary of VOUC

Item		Unit	Passenger Car	Microbus	Regular Bus	Light Truck	Heavy Truck
Representative Vehicles / Make / Model			Mazda323 2000	Mazda E2000 2000	Man 2000	Daihatsu 2000	Mercedes 2000
VOUC subject to Distance							
Speed (km/hr)	5	SP/km	5.19	1.86	17.41	2.78	13.85
	10	SP/km	4.38	1.71	15.19	2.62	11.63
	20	SP/km	3.99	1.64	14.11	2.55	10.56
	30	SP/km	3.88	1.62	13.80	2.53	10.24
	40	SP/km	3.86	1.62	13.70	2.53	10.14
	50	SP/km	3.88	1.62	13.69	2.54	10.14
	60	SP/km	3.92	1.64	13.75	2.55	10.19
	70	SP/km	3.99	1.66	13.85	2.57	10.29
	80	SP/km	4.07	1.68	13.98	2.59	10.43
	90	SP/km	4.17	1.71	14.15	2.62	10.59
VOUC subject to Time		SP/hr	8.59	52.81	182.59	53.91	163.61

Table 15.1.3 Summary of TTUC (2000, 2005, 2010, 2015, 2020)

Item/Year	Unit	2000	2005	2010	2015	2020
GDP/capita	SP/year/psn	48,191	57,318	67,309	77,152	87,744
Index to 2000 in GDP/capita		1.00	1.19	1.40	1.60	1.82
TTUC	SP/hour/psn	14.5	17.2	20.2	23.2	26.4

Table 15.1.4 Freight Time Unit Costs

Item	Yearly Time Cost (MSP/ton/yr)	Hourly Time Cost (SP/ton/hr)	Note
1-crude oil	0.00384	0.43829	
2-petroleum products	0.00384	0.43829	
3-natural gas	0.00868	0.99139	
4-cement	0.00344	0.39228	
5-construction materials	0.00769	0.87818	
6-phosphate	0.00095	0.10846	
7-iron	0.00590	0.67340	
8-coal and coke	0.00095	0.10846	In conformity to phosphate
9-other minerals	0.00095	0.10846	In conformity to phosphate
10-wheat	0.00867	0.98996	
11-cereals	0.00961	1.09728	
12.1-Vegetables	0.00633	0.72291	
12.2-Fruit	0.04421	5.04658	
13-Suger Beet	0.00123	0.14037	10% of Sugar
14-Rice	0.01377	1.57193	
15-Cotton	0.03627	4.14064	
16-Livestock	0.07642	8.72418	
17-Animal Products	0.14398	16.43593	
18-Agriculture Products	0.06365	7.26608	
19-Suger	0.01230	1.40374	
20-Food Oil	0.02807	3.20435	
21-Animal Fodders	0.01237	1.41234	
22-Beverages	0.01872	2.13663	
23-Other Food Products	0.00356	0.40671	
24-Chemical Products	0.04112	4.69439	
25-metal products	0.03419	3.90282	
26-textiles and clothes	0.09583	10.93954	
27-fertilizer	0.00767	0.87550	
28-paper	0.02235	2.55110	
30-manufactured commodities	0.22051	25.17220	
31-mixed commodities	0.02419	2.76144	Including house use commodities
32-cork and wood	0.01496	1.70826	

Note: MSP= Million SP in 1995 price adjusted changing rate at the time

15.1.2 Investments

Investment schedule is summarized in Table 15.1.5.

Table 15.1.5 Investments Schedule

(unit: MSP)

Year	Land	Buildings	Machinery	Comm-unication	Cables	Signals	Roadbed	Rails	Engineering	Total
2001	505	1,100	30	206	220	391	2,597	1,179	286	6,514
2002	709	3,200	630	207	221	392	3,860	2,753	563	12,535
2003	608	2,700	430	207	221	392	4,141	3,423	576	12,698
2004	423	2,200	490	207	221	392	3,591	3,587	534	11,645
2005	240	1,600	270	209	225	396	2,783	3,186	433	9,342
2006	303	0	0	212	221	427	3,832	2,299	350	7,644
2007	228	150	0	212	221	427	4,283	3,632	446	9,599
2008	138	1,200	150	212	221	427	4,198	4,131	527	11,204
2009	35	800	50	212	221	427	2,494	4,032	412	8,683
2010	0	0	0	215	222	431	243	4,179	265	5,555
2011	59	0	0	112	44	123	284	710	64	1,396
2012	51	500	0	112	44	123	277	989	102	2,198
2013	38	2,000	400	113	44	123	246	1,026	198	4,188
2014	35	1,500	200	113	44	124	237	897	156	3,306
2015	0	0	0	115	47	125	169	1,019	74	1,549
2016	44	0	0	95	9	98	79	312	30	667
2017	80	0	0	95	9	98	224	352	39	897
2018	4	0	0	95	9	98	463	547	61	1,277
2019	4	0	0	95	9	98	413	682	65	1,366
2020	0	0	0	96	9	100	42	773	51	1,071
Total	3,504	16,950	2,650	3,140	2,482	5,212	34,456	39,708	5,230	113,332

GESR enjoys 100% return of taxes from the Government. Unemployment rate is low in labor force because the Syrian economy is based on the Social Economy. Because of these reasons the Study Team does not apply financial to economic cost conversion.

Major portion of Administration and Operation Costs (AOC) is personnel costs excluding crew costs. Personnel costs are calculated by the formula; Personnel cost in MSP = number of personnel x 84,500 / 1,000,000. Another item of AOC is maintenance costs of tracks and communication lines, which is a function of operation activities. The formula; Maintenance costs of tracks and communication lines in MSP = passenger-ton km / year x 0.096 / 1,000,000, is applied for the estimates.

For the EIRR calculation the difference of AOC between the Master Plan and the Do Nothing Cases is calculated and tabulated in Table 15.1.6.

Table 15.1.6 Difference of Administration and Operation Costs between Master Plan and Do Nothing Cases

Year	Difference in No. of Employees (exc. Crew)	Difference in Salary (MSP/year)	Other Operating Exp. (MSP/year)	Difference in AOC (MSP/year)
2000	0	0	0	0
2001	-187	-16	0	-15
2002	-373	-32	1	-31
2003	-560	-47	1	-46
2004	-746	-63	2	-62
2005	-933	-79	2	-77
2006	-830	-70	2	-68
2007	-728	-61	3	-59
2008	-625	-53	3	-50
2009	-523	-44	4	-41
2010	-420	-35	4	-31
2011	-234	-20	5	-15
2012	-49	-4	6	2
2013	137	12	7	18
2014	322	27	8	35
2015	508	43	9	52
2016	742	63	10	73
2017	977	83	11	94
2018	1,211	102	13	115
2019	1,446	122	14	136
2020	1,680	142	15	157

15.1.3 Benefit

Benefit results from the difference in ROC, VOC and TTC of the present network those of the proposed network when the same OD volume is assigned. Benefits of the Master Plan are calculated for each five (5) year period as shown in Table 15.1.7.

Table 15.1.7 Benefits of Years 2005, 2010, 2015 and 2020

(unit: SP/year)

Item	Master Plan Network	Do Nothing Network	Do Nothing-Master Plan
2005			
VOC sum	54,165,106,568	56,948,153,764	2,783,047,196
ROC sum	2,192,429,858	1,724,918,203	-467,511,655
TTC	6,014,040,985	6,858,797,486	844,756,501
Total Benefits	62,371,577,411	65,531,869,453	3,160,292,042
2010			
VOC sum	76,580,527,177	86,858,331,850	10,277,804,673
ROC sum	3,197,781,394	2,354,511,429	-843,269,965
TTC	6,875,468,162	10,257,633,744	3,382,165,583
Total Benefits	86,653,776,733	99,470,477,023	12,816,700,291
2015			
VOC sum	113,225,513,250	138,105,287,187	24,879,773,937
ROC sum	5,155,996,935	3,245,709,040	-1,910,287,896
TTC	9,987,496,022	15,699,060,058	5,711,564,036
Total Benefits	128,369,006,207	157,050,056,285	28,681,050,077
2020			
VOC sum	168,097,373,013	216,419,822,203	48,322,449,190
ROC sum	7,775,933,466	4,649,425,736	-3,126,507,729
TTC	15,212,200,880	24,193,043,007	8,980,842,127
Total Benefits	191,085,507,359	245,262,290,947	54,176,783,588

15.1.4 Economic Analysis

Economic IRR was calculated based on the abovementioned conditions. Results, which are shown in Table 15.1.8, were EIRR; 16.9%, NPV; 28,461 MSP and B/C; 1.43 under 12% discount rate.

Table 15.1.8 Economic IRR, NPV, B/C of Master Plan

(unit: MSP)

Year	Initial Invest.	Diff. of Maint. Costs.	Costs Total	Benefit	B-C	Discounted Values		
						Cost	Benefit	B-C
2001	6,514	-15	6,499	632	-5,867	6,499	632	-5,867
2002	12,535	-31	12,504	1,264	-11,240	11,165	1,129	-10,036
2003	12,698	-46	12,652	1,896	-10,755	10,086	1,512	-8,574
2004	11,645	-62	11,584	2,528	-9,056	8,245	1,800	-6,446
2005	9,342	-77	9,266	3,160	-6,105	5,888	2,008	-3,880
2006	7,644	-68	7,576	5,092	-2,484	4,299	2,889	-1,410
2007	9,599	-59	9,541	7,023	-2,518	4,834	3,558	-1,276
2008	11,204	-50	11,154	8,954	-2,200	5,046	4,050	-995
2009	8,683	-41	8,642	10,885	2,243	3,490	4,396	906
2010	5,555	-31	5,523	12,817	7,294	1,992	4,622	2,630
2011	1,396	-15	1,381	15,990	14,609	445	5,148	4,704
2012	2,198	2	2,200	19,162	16,962	632	5,509	4,876
2013	4,188	18	4,206	22,335	18,129	1,080	5,733	4,653
2014	3,306	35	3,341	25,508	22,167	766	5,846	5,080
2015	1,549	52	1,601	28,681	27,081	328	5,869	5,541
2016	667	73	740	33,780	33,041	135	6,172	6,036
2017	897	94	991	38,879	37,888	162	6,342	6,180
2018	1,277	115	1,392	43,978	42,587	203	6,405	6,203
2019	1,366	136	1,502	49,078	47,576	195	6,382	6,187
2020	1,071	157	1,228	54,177	52,949	143	6,290	6,148
R.V.	67,175			67,175	67,175	0	7,800	7,800
Total						65,630	94,091	28,461
IRR:	16.9%	B/C:	1.43	NPV:	28,461	MSP under Discount Rate		12%

Note: R.V. = Residual Value

Sensitivity analysis shows that the 12% of EIRR is assured up to the conditions where benefits are reduced to 0.3 times of the standard case or costs increased to 1.4 times of the standard case. The results are shown in Table 15.1.9.

Table 15.1.9 Sensitivity Analysis Results

Cost \ Benefit	1	0.95	0.9	0.8	0.7
1	16.9	16.1	15.4	13.7	11.9
1.05	16.2	15.4	14.7	13.1	11.3
1.1	15.5	14.8	14.0	12.4	10.7
1.2	14.3	13.6	12.8	11.3	9.6
1.3	13.2	12.5	11.8	10.3	8.6
1.4	12.2	11.5	10.8	9.4	7.7

15.2 Financial Analysis

15.2.1 Objectives and Method of Analysis

The purpose of financial analysis is to verify how much the project is profitable and can contribute to improvement of financial standings of the enterprise. As index for the analysis, Financial Internal Rate of Return (FIRR) is used.

15.2.2 Main Prerequisites

(1) Period of the Analysis (Project Life)

The evaluation of the project is made for 40 years from 2001 to 2040.

(2) Demand Forecast

The traffic demand is assumed to keep the same level in and after 2020, the final year for which the forecast is conducted.

(3) Inflation

Inflation is disregarded in the analysis.

(4) Revenue

1) Fare Revenue

Fare revenue is calculated by multiplying unit fare price by the transport volume increased by implementation of the Master Plan.

Unit fare prices per kilometer are as follows.
Freight: Syrian Pounds 0.8869 / ton
Passenger: Syrian Pounds 0.1755 / person

2) Miscellaneous Revenue

Miscellaneous revenue is assumed to be 3% of the fare revenue.

(5) Investment Cost

In financial analysis investment cost is indicated in market price.

(6) Depreciation

GESR's rule provides that depreciation of fixed assets should be made by straight-line method and yearly depreciation (percentage on purchase price) is established for various kinds of equipment.

However, the equipment is usually used during its physical durable years as far as it can be operated economically. In this analysis, it is assumed that the assets are used to twice as long as its legal or financial durable years. In this case depreciation is continued after the amount of the purchase price is fully accumulated, but the rate of depreciation per year is reduced to half accoding to the rule established by Syrian Ministry of Finance.

As for facilities for signal and telecommunication, appropriate rates of depreciation and durable years are set referring to JR's rule in Japan and it is assumed that the replacement is made at the end of the financial durable years. Table 15.2.1 shows the rates of yearly depreciation and the physical durable years.

Table 15.2.1 Rates of Depreciation and Durable Years of Fixed Assets

Item	Rates of Depreciation per Year		Physical Durable Years
	Up to 100% of Purchase Price	Over 100% of Purchase Price	
Buildings & Structures	2%	1%	100 years
Machinery & Equipment	5%	2.5%	40 years
Rolling Stock			
Locomotives & Diesel Cars	7%	3.5%	28 years
Coaches, Wagons & Tankers	4%	2%	50 years
Signals & Telecommunications			
Computors & Electric Equipment	8.33%		12 years
Signals & Warnings for Crossing ets.	5%		20 years
Cables	3.33%		30 years

(7) Fund Raising

1) Financing in Foreign Currency

Foreign currency portion of the initial investment cost will be financed by foreign currency loan from international or overseas financial institution. Following two types of loans are assumed in the analysis. It has been confirmed by the lending institutions concerned that the following terms and conditions are applicable to Syria.

① Loan Condition 1

Interest: 2.2% p.a.

Grace: 10 years

Repayment: 30 years semiannual equal installment

② Loan Condition 2

Interest: 0.75% p.a.

Grace: 10 years

Repayment: 35 years from 11th to 20th year: 2.5% of total loan amount
from 21st to 35th year: 5% of total loan amount

2) Financing in Local Currency

The balance of the investment cost is covered by funds in local currency. It is assumed that Syrian Government will pay the total amount of local funds as equity.

15.2.3 The Results of the Analysis

(1) Financial Internal Rate of Return (FIRR)

There are two kinds of FIRR, i.e. Return on Investment (ROI) and Return on Equity (ROE). ROI is the rate of return on total investment and indicates the profitability of the project. On the other hand, ROE is the rate of return on equity. Sensitivity analysis is made for the following five cases.

Case 1 5% Increase of Total Investment Cost
Case 2 10% Increase of Total Investment Cost
Case 3 5% Decrease of Total Revenue
Case 4 10% Decrease of Total Revenue
Case 5 10% Increase of Total Investment Cost and 10% Decrease of Total Revenue at the same time

Main indices of the analysis including FIRR are shown in Table 15.2.2.

Table 15.2.2 Main Indices of Financial Analysis

(Unit: Million Syrian Pounds)

Case	Loan Condition	ROI	ROE	Local Funds	
				Peak(2003)	Cumulative
Base Case	1	2.0%	2.0%	7,148	56,153
	2		4.2%	6,903	47,101
Investment 5% up	1	1.8%	1.5%	7,530	60,580
	2		3.7%	7,274	49,964
Investment 10% up	1	1.5%	1.1%	7,913	65,209
	2		3.3%	7,644	52,828
Revenue 5% down	1	1.7%	1.4%	7,181	58,356
	2		3.5%	6,937	47,769
Revenue 10% down	1	1.3%	0.7%	7,215	60,988
	2		2.9%	6,970	48,437
Investment 10% up Revenue 10% down	1	0.9%	-0.1%	7,980	75,430
	2		2.0%	7,711	54,464

FIRR (ROI) of this project for the base case is 2.0%. It cannot be denied that this figure is not on sufficiently high level, but if the loan with favorable condition (Loan Condition 1 or 2) is available and the local portion of the project is financed by Syrian Government with no interest, the project is feasible. According to the results of the sensitivity analysis, the project is feasible even in the worst case in case for loan condition 2 (increase of investment cost is 10% and decrease of revenue is also 10%) and unfeasile in case of Loan Condition No. 1. The results of the sensitivity analysis show that even the small change for the worse of the prerequisites will decrease the feasibility of the Master Plan. In this connection cost overrum must be carefully controlled and much effort must be made for increasing demand.

(2) Indices for Management Analysis

Table 15.2.3 shows the forecast of the transport volume per personnel compared with the records in 1999 of the countries in which the railway has performed important role. By implementing the Master Plan, productivity of GESR is expected to improve to the international standard level.

Table 15.2.3 Passenger/Ton・Km per Employee

(Unit: '000 Ton・Km)

Year	1999	2005	2010	2015	2020
GESR	164	314	495	790	1,143
Korea	1,281				
Japan	1,428				
Russia	1,790				
Canada(CN)	3,715				
Canada(CP)	4,970				
South Africa	1,005				
France	566				
Sweden	980				

(3) Profitability

Table 15.2.4 shows the years in which the profit and loss accounts of the Project turn from deficit into surplus.

Table 15.2.4 The Years Turning from Deficit into Surplus

(Unit: Million Syrian Pounds)

Case	Loan Condition	Year Turning into Profit	
		Yearly	Cumulative
Base Case	1	2018	2029
	2	2016	2021
Investment 5% up	1	2019	2031
	2	2016	2022
Investment 10% up	1	2019	2033
	2	2016	2024
Revenue 5% down	1	2019	2032
	2	2016	2023
Revenue 10% down	1	2020	2035
	2	2017	2026
Investment 10% up Revenue 10% down	1	2025	2040
	2	2019	2031

(4) Cash Flow

In the assumption of the financial analysis, it is expected that the foreign currency portion of the initial investment equivalent to 104,915 million Syrian Pounds will be covered by loans from overseas or international financial institution for economic cooperation and local currency portion will be supplied by Government budget. Necessary amount of local currency funds are 56,153 (in case of loan condition 1) or 47,101 (loan condition 2) million SP respectively according to the difference of interest rate and repayment schedule.

The total of GESR budget from 2001 to 2020 amounts to 169,269 million SP (2000 constant price, the estimate by the Study Team Chapter 6, Table 6.3.3) which enough cover the amount of investment including both foreign and local currency funds required during the master plan period. Looking into details, however, annual amount of budget is not always sufficient for the investment cost of the year especially at the beginning stage of construction. Therefore to avoid the temporary shortage of funds it is important to pay attention to the following two points.

1. To take up the urgent and efficient projects preferably and to put off others as soon as possible taking the priority of investment into consideration
2. To look for the loan with as favorable condition as possible

(5) Evaluation and Recommendation

The FIRR of the Master Plan on the Development of Syrian Railway is not high enough. Therefore it is important to take care of control of the investment cost and to attract passengers and cargo increasing fare revenue as much as possible. It is also necessary to look for loans with as favorable terms and conditions as possible. The terms and conditions of loan presented in 15.2.2. (7) are applicable to any country in the same developing stage as Syria. It has been confirmed by the lending institutions concerned.

Chapter 16 Improvement plan of GEHR

16.1 Future Role of Hidjaz Railways

The present and future roles of the Hidjaz Railways can be considered as follows: (1) Long-haul to Amman, (2) Tourism promotion, (3) Transport means to the Damascus Airport and (4) Transport service inside Damascus City. Two of these; long haul to Amman and tourism promotion to Surghaya are presently in operation while the other two are under study or design.

(1) Long-haul to Amman

Presently GEHR operates two couples of trains a week to Amman in cooperation with the Jordanian Hidjaz Railways.

GEHR, in collaboration with Jordan Railways, is planning to convert the meter-gauged line to standard gauged line between Damascus ~ Jordan border to be connected to Jordan's standard gauged line (to be converted from meter gauge). In addition, the construction of tracks of standard gauge is on going on the Syrian side by GESR. New investments to the said long-haul business must be examined from economic and financial view point. However the importance of this route for linking two Arab countries should not be overlooked.

(2) Tourism Promotion

The major purpose of the train trips to Surghaya is for having picnics outdoors, especially during the Summer Season.

It is expected that this line may play an important role in domestic tourism because of the scenic area it serves in and the poor road conditions there.

(3) Transport Mean to Damascus Airport

There are plural transport demand sources to the Damascus Airport Line; one is by the passengers using the airport, the second by the employees working in the Airport, and the third by possible commuters to Damascus city along the line.

GEHR is planning to construct standard gauged airport line connecting Hedjaz Station, Kadam Station and the airport. JICA Study Team has been informed by GEHR that design between Hedjaz and Kadam has been partially started. _The railway route to the airport

should be studied in combination with the surface road network, but the demand along that route is expected to continue to grow.

(4) Transport Service inside Damascus City

Minibuses and taxis provide public transport services in Damascus City. However Damascus city is a very large populated area. Accordingly for effective urban transport, not only bus and automobile services, but also rail based guided transport system would surely be necessary in due time.

In case it is decided to introduce such a guided transport system, GEHR may be a candidate to operate that system. However, guided urban transport system is generally unfeasible from the viewpoint of financial viability due to various inevitable reasons. In this regard, in constructing and operating a guided transport system, appropriate financial support by the Government must be duly considered.

16.2 Policy for Improvement of GEHR

GEHR is now seriously planning to modernize its railway system through gauge conversion from the current meter gauge to the standard gauge, the same gauge as that of GESR.
Its major plans are as follows:

(1) Construction of Damascus Airport Line

(2) Construction of standard gauged line between Kadam and Jordan Border

The advantages of such conversion will be (1) to be able to integrate GEHR and GESR into the same gauged unified railway network all over Syria, and (2) to promote intra-and inter-regional railway transport.

However, because conversion to standard gauge from meter gauge requires considerable amount of investment, it must be carefully examined from the view point of national economy and financial viability of railway enterprise. Bearing in mind the above discussion, and because the gauge conversion is not yet justified from the economic and financial view point, JICA Study Team has presented the improvement plan of existing lines with minimum investment to ensure the operation safety in the section 16.3. However, gauge conversion can be programmed as soon as its economic and financial justification can be ensured. JICA Study Team presented its views on modernization of

GEHR through gauge conversion in the section 16.4.

16.3 Improvement plan of Existing Lines

16.3.1 Policy of the improvement plan of existing lines

Basic policy of the GEHR improvement plan is intended to ensure a safety operation of trains with the minimum investment based on the existing conditions of railway facilities and provisions.
As to track facilities, therefore, it is limited to make only the minimum rehabilitation.
Concerning traffic signals and telecommunication facilities, it is intended to upgrade the safety operational level by provision of new signal and telecommunication facilities at stations, which have no signal and telecommunication facilities. In addition, warning installations are to be planned as a countermeasure at the level crossings where a traffic volume of vehicles is a lot.
Regarding a rolling stock, nondestructive inspection devices for important accessories are to be prepared.

16.3.2 Track facilities

(1) Improvement of the track facilities and the construction plan of new lines.

The GEHR decides the priority order of projects as follows.

1) Rehabilitation of the track facilities in the Daraa line and the re-routing of line between Al-Qadam and Hidjaz stations are picked out as the first priority project.

2) Rehabilitation of the track facilities for the Surgaya line as the second priority project.

3) Rehabilitation of the track facilities for the other lines as the third priority project. Discussions are being made concerning the Air Port new line construction project and examination on tram routing lines.

(2) Principle and Investment amount for the improvement of track facilities

The GEHR plans amelioration of the track structures by replacing the existing sleepers with concrete and PC sleepers for 30kg/m-rails.

Rehabilitation of the railway (track) is expected to require roughly about 1,164 million Syrian Pound (rehabilitation of Qatana line is excluded)

16.3.3 Signal and Telecommunication Facilities

(1) Basic Policy

At present a single train per day is operated in most lines. When more than 2 trains will be operated in near future, it is necessary to install interlocking device in the station, block system between stations, dispatching telephone, data transmission system, etc.

(2) Interlocking Device

For operational safety, the color light signals are to be equipped and the switches are to be controlled by the interlocking device.

(3) Block System

It is necessary to equip token-less block systems between stations.

(4) Telecommunication Cable and Devices

Complexed optical fiber cables are installed in all lines and the devices of OPT MUX P (1.5MHz) are equipped in every stations.

(5) Power Supply

The power supply systems for signal and telecommunication facilities are equipped in all stations.

(6) Railway Level Crossing Equipments

The automatic level crossing devices should be equipped in the level crossing where the traffic density is comparatively high. (Considering to legislate for railway priority).

(7) Train Detection Equipments

‘ Axle Counters’ or the similar equipments as train detection system are to be installed.

(8) Maintenance Standards

At present, there are no maintenance standards for signal and telecommunication

facilities.

But it is supposed that signal and telecommunication facilities will increase in near future, so it is necessary to prepare the maintenance standards.

16.3.4 Rolling stock

(Unit: Million SP)

Test equipment name	Quantity	Price
Ultrasonic flaw detector	1	2
Magnetic flaw detector	1	3
Amounts		5

16.3.5 Total amount of investment cost

The GEHR improvement plan is expected to require about 1,677million Syrian Pound as a necessary cost for the first and second priority projects.

Breakdown of that total amount is about 1,367 million SP for the renewal of track facilities, about 296 million SP for signaling and telecommunication facilities and about 5 million SP for inspection devices of rolling stocks.

The rehabilitation cost of the third priority project will be about 443 million SP.

It is recommended that the first and the second priority projects should be executed in the first place.

It is necessary, however, that the GEHR should examine a re-routing of the line between Al-Qadam and Al-Hidjaz in cooperation with the GESR because GESR has the construction plan of a new line in the same section.

The plan should be established in due consideration for a future condition of the Surgaya line.

16.3.6 Management and Operations

Staff of Railway Transport Sector, earning the revenue of less than 7%, accounts for about 50% of personnel in the GEHR.

Accordingly strict cost control should be essential in management of Railway Transport Sector.

While the most of railway facilities become deteriorated, due considerations should be given to the necessary replacement of the facilities, the installation of railway level crossing devices,

education and training of staff from the view point of safety railway operation.

16.4 Modernization of GEHR Through Gauge Conversion (meter gauge to standard gauge)

Regarding the gauge conversion plan of GEHR as referred to the section 16.2, JICA Study Team will present its views on these plans and gauge conversion of the other lines a follows.

(1) Airport Line Project

The traffic demand should be, in the first place, examined carefully, taking into consideration the various factors. Then economic and financial viability of the project should be examined carefully. (It should be mentioned that the Airport Line Project is not included in the projects taken up in the JICA Study of this time, because the Airport Line is a suburban railway which requires methods of demand forecast entirely different from those used in Master Plan Study.)

(2) The Damascus – Daraa – Jordanian Border Line

1- Integration of the GESR Plan and the GEHR plan into a single national plan.
2- In executing this project, it is necessary to sufficiently analyze its economic and financial feasibility.
3- The section between Damascus and Daraa has a significance by itself because it connects the state capital and the Governorate capital. However, the construction of the section between Daraa and the Jordanian border will have its meaning, only when the construction of the Jordanian – side route is executed at the same timing.

(3) Regarding the standard – gauge introduction to lines other than the above two lines.

1- It is advisable to modernize Qatana line by transforming its tracks into standard gauge, at the time when the line should be revitalized as a Damascus suburban line.
2- When a large increase in transport demand is estimated in the future or when the needs for developing Susrygaya line into international railways connecting Damascus and Beirut are recognized, it is recommended to modernize Saryaya line into a standard-gauge track railway system after confirming its economic and financial feasibility.

(4) When standard –gauge tracks are introduced to some GEHR lines, these lines should be integrated with the GESR network to create a single railway network in Syria. In this case, the following two methods are considered as the ways of operating GEHR lines.

1- GEHR not only owns facilities/equipments but also conducts assets administration, together with business administration and operation.

2- GEHR owns facilities/equipments, and conducts passenger transport and real estate business, but maintenance of facilities/equipments and freight transport are entrusted to GESR on contract basis.

(5) Concluding Remarks

The gauge conversion to standard gauge has various advantages. Accordingly, when the investment to gauge conversion of GEHR can be justified from the economic and financial view point, modernization of GEHR through the gauge conversion can replace the rehabilitation of the existing meter-gauged lines. In studying the gauge conversion project, the above mentioned comments (1)~(4) should be duly taken into consideration.

Chapter 17 Natural Conditions and the Environment

17.1 Natural Conditions and Land Use

17.1.1 Geographic and Topographical Features

GESR routes have no difficulty in following the topographic terrain in which they pass, except for Aleppo – Lattakia, Tartous – Al-Kabir and Aleppo – Midan Ekbas routes that pass through mountainous terrain. Tartous – Al-Kabir and Aleppo – Midan Ekbas routes include many successive steep gradients (more than 20‰) and sharp curves (R ≦ 300 – 500 m).

GEHR routes pass through mild terrain in Syria's southeastern region. However the Daraa – Haifa route along the Jordanian border passes through the steep Wadi Yarmouk valley.

17.1.2 Land Use

Agriculture: The cultivable area in Syria is around 6 million hectares, or 32% of the total land area of the country. In addition there are 8.2 million hectares of steppe and pastureland. Rainfall remains the dominant water source for agriculture. In 1998 the main crop produced was wheat at 4,112 thousand tons, followed by vegetables (2,502 thousand tons), and sugar beet (1,202 thousand tons).

Industry and Mining: Industrial activity is located along the Damascus – Aleppo axis and the coastal axis of Lattakia – Tartous. Mining activities, especially phosphate, are in the eastern desert in Homs and crude oil and natural gases are extracted from Hassaka and Deir el-Zor. Environmental problems of wastewater, solid waste and air emissions exist.

Rivers and Conservation areas: There are 18 rivers in Syria; the longest is the Euphrates River (2,880 km), followed by Orontes River (485 km). Most of the rivers are heavily polluted. Some rivers are dry most of the year, such as Barada, Al Jagiagh and Al Khabour. There are 34 protected areas, of which 28 are identified. These include natural and scenic sites, as well as historic sites.

Land use in the GESR and GEHR facilities surroundings

The land use surrounding the GESR routes is described in Table 17.1.1.

Table 17.1.1 Land Use along GESR Routes

No.	Route/ Land use characteristics
1.	Damascus – Homs (200 km) The route passes through desert area up to north of Mhine, then it passes through pastures and agricultural lands as it enters into Homs. Industries are located north of Damascus and at the entrance of Homs.
	Homs – Hama (56 km) The route continues north passing through agricultural lands up to Hama.
	Hama – Aleppo (139 km) The route continues north through agricultural land. The route passes through the urban fabric of Aleppo and four stations serve that city.
2.	Lattakia – Aleppo (205 km) From the port city of Latakkia in the west the route travels northeast towards Aleppo. Between Lattakia and Mhambel, south of Idlib the route passes through mountainous areas and forests. The topography changes north of Mhambel station into rolling plains with agricultural activities. This condition continues to Aleppo.
	Aleppo – Deir el-Zor (340 km) The route travels eastwards from Aleppo where the land use is mainly pastureland but then develops into agriculture land dependent on the Euphrates river.
	Deir el-Zor – Qamishli (211 km) The route travels from Deir el-Zor northeast towards Qamishli passing through mainly flat cultivable lands irrigated by the Khabour River.
3.	Homs – Tartous (102 km) The route from Homs, westwards towards Tartous, passes through agricultural lands up to the city of Tel Al Kalakh. From that point to Tartous the route mainly passes through forests and some agricultural lands.
	Tartous – Lattakia (88 km) From Tartous northwards to Lattakia the route moves near the coast passing through mixed land use of agriculture, residential and industries.
4.	Mhine – Al-Sharqia (111 km) The route travels eastwards through desert area to Al-Sharqia, mainly to serve the phosphate mines.

The GEHR network is confined to the south in the three governorates of Damascus, Daraa and Soueida. The longest section is Damascus – Daraa (126 km). The route from Hijaz station in the north passes through the urban fabric (with about seventeen surface crossings) till it reaches Kadam station. It continues south through uncultivable semi-desert land reaching the city of Shinshar. From Shinshar southwards to Al Mismieh city the land use surrounding the track is mainly pasture land with some cultivation. From Al Mismieh southwards to Daraa the land is predominantly agriculture.

The two routes extending from Daraa, westbound to Zeizoun and eastbound to Bosra Al

Sham pass through agriculture land for about 10-15 km each side of Daraa. The Zeizoun line passes along a river ravine. The eastbound Bosra Al Sham line continues through desert land till it reaches the tourist city of Bosra Al Sham.

17.2 Environment related Institutions and Legislation

17.2.1 Institutions

The Syrian Government was the first Arab country to establish a specific ministry for the environment in 1987. The highest authority in the government responsible for implementing environmental protection resides in the Supreme Council for Environmental Protection.

The internal organization structure of both GESR and GEHR calls for the attachment of a *department for internal protection and industrial safety* to the general director's office. The duties of this department include prevention of environmental pollution generated by railway activities. However this department in reality does not deal with any environmental issues.

17.2.2 Draft Environment Protection Law

Since 1995 there have been a number of drafts for an environmental protection law prepared. The latest draft prepared in 2000 and under consideration by the government discusses the environmental impact assessment procedure.

Therefore at this time there is no legal requirement for EIA or any technical guidelines. Accordingly this study examines the environmental impact of the proposed projects based on the JICA guidelines and other relevant literature.

17.2.3 Land Appropriation and Resettlement

Land appropriation may be required in the following railway projects:

- ⇒ Construction of new lines
- ⇒ Doubling of existing lines
- ⇒ New workshop construcntion

Land appropriation is possible for two types of projects:

⇒ Urban expansion governed by Law no. 60 for 1979

⇒ Projects of public benefit nature governed by law no. 20 for 1983

Transport projects are in many cases considered as public benefit projects and are subject to the provisions of law no. 20 for 1983 when property appropriation is required.

Land appropriation for projects of public benefit usually takes a long time in preparing the compensations whether monetary or provision of substitute housing.

17.3 Initial Environmental Examination

17.3.1 Introduction

(1) Environmental Issues on the National Level

The most recent study reports have identified the priority environmental issues on the national level in order of importance as follows;

1. Soil degradation
2. Contamination and depletion of water resources
3. Poor air quality
4. Inappropriate solid waste disposal
5. Growth of illegal settlements

The railway projects proposed in the master plan do not aggravate these identified issues.

(2) Environmental Problems generated from the present Syrian Railway service

While the purpose of this examination is to determine the impacts that may be generated by the proposed projects on the environment, it is also necessary to evaluate if the proposed projects will contribute to mitigating some of the present negative impacts. Accordingly the present environmental issues with respect to GESR and GEHR operation have also been studied.

17.3.2 Master Plan Projects

The master plan projects are for both GESR and GEHR. The GESR projects are classified into five project groups. The five project groups and a brief description of their components relevant to the environmental examination are shown in Table 17.3.5.

Table 17.3.5 Master Plan GESR Project Groups

GESR Project Group	
Brief description	Environmental Benefits/ Concerns
Group 1 – Rehabilitation, Modernization of Existing Lines	
• 8 lines are targeted	• Improvement of train operation safety will decrease accidents • Increase of rail carrying capacity and service reliability will reduce road transport and associated air pollution • Allocation of land for new stations and laying double tracks not a problem as long as these lands are inside existing railway ROW
Group 2 – New Line Construction	
• 5 new lines are planned	• Construction of the new lines will provide a more comprehensive Syrian railway network to serve both domestic and international traffic and decrease reliance on road traffic. • Importance of route selection and effect the selected route has on surrounding socioeconomic conditions, land appropriation and resettlement, ease of construction, scenery, etc. • Environmental impacts generated during construction and noise during operation
Group 3 – Workshop Improvement	
• Construction of Jubrin locomotive and diesel car workshop • Construction of Aleppo passenger coach workshop • Construction of Jubrin freight wagons work shop	• New workshops will ensure more reliable and safer service and better working conditions • Modernized facilities will improve present waste management • Measures to mitigate environmental effects during construction (generated waste) and operation (waste discharged and noise) need to be considered in the design and implementation stages.
Group 4 – Rolling Stock	
Introduction of the following rolling stock: • Locomotives: 286 units • Diesel cars: 240 units • Passenger coaches: 39 units • Freight wagons: 13,343 units	• Availability of rolling stock will ensure more reliable and safer service • The new rolling stock should be of technical superiority to have minimum possible air pollutant emissions and noise • The freight wagons should be of technical superiority to provide safe loading and unloading conditions and prevent leakages and spoilage of hauled goods
Group 5 – Freight Information System	
Introduction of computer system linking all GESR freight stations in order to input and provide real time data.	• Provision of more efficient service will attract more freight transport to rail from road and improve wagon capacity use • No negative environmental effects predicted. Group 5 is excluded from further environmental consideration at this time.

Four projects are considered in the improvement plan for GEHR. Table 17.3.6 describes these projects and environmental benefits and impacts that may be expected from them.

Table 17.3.6 Master Plan GEHR Projects

GEHR Projects	
Brief description	Environmental Benefits and Concerns
Project 1 – Rehabilitation of Damascus – Daraa line (including Hidjaz station – Qaddam underground section)	
• This line is 128 km long and has 13 stations	• Improvement of train operation safety will reduce chance of accident occurrences • Rehabilitation works at existing stations must not effect their historical value
Project 2 – Rehabilitation of Surghaya line	
• This line is 58 km long and has 9 stations	• Increase of rail carrying capacity and reliability of service will reduce road transport and associated air pollution from road traffic in this scenic area
Project 3 – Rehabilitation of Qatana, Bosra and Muzeireeb lines	
• The line lengths are; Qatana 24 km, Bosra 41 km, and Muzeireeb 26 km and total number of stations is 15	• Increase of rail carrying capacity and reliability of service will reduce road transport and associated air pollution from road traffic
Project 4 – New Rail service to Damascus airport	
• This project is expected to provide rail transport between the city center and airport within a distance of 30 km	• Will provide an alternate mode for the present sole road connecting to the airport and reduce road congestion as traffic demand increases • Importance of route selection and effect the selected route has on surrounding socioeconomic conditions, land appropriation and resettlement, ease of construction, scenery, etc. • Environmental impacts generated during construction and noise during operation

17.3.3 Screening and Scooping

The JICA guidelines for initial environmental examination of railway projects were adopted and are used hereafter. During the screening process the environmental items that may be impacted by the projects groups were identified. The scoping process followed in order to determine the seriousness of the potential impact.

The scoping exercise for the GESR project groups shows serious environmental concerns for social environmental issues that may be generated by land allocation and resettlement for the new lines. Results are shown in Table 17.3.9.

Table 17.3.9 Scooping of Master Plan GESR Project Groups

Environmental Item	Group 1	Group 2	Group 3	Group 4	Remarks
Social Environment					
Resettlement	D	A	D	D	Group 2: Large resettlement may be required for projects N2, N4, N7 and N8
Economic Activities	D	C	D	D	Group 2: New lines N3 and N5 may separate farmers and shepherds from their farms and pastures
Traffic and public facilities	D	B	D	D	Group 2: Passenger and freight traffic will be attracted to new stations and these will effect surrounding traffic
Split of communities	D	C	D	D	Group 2: Ethnic communities residing along the proposed new lines N2 and N6 and Bedouin communities freely roaming in the area of N3 may be effected
Cultural property	D	A	D	D	Group 2: N3 route must be carefully considered so as not to impact the world heritage site of Tadmour, and proposed new lines in ancient cities of Damascus and Aleppo must avoid antiquities above and under ground.
Public health condition	D	D	C	D	Group 3: Health of workers in the new workshops and surrounding residents must be carefully considered in the facility design and operation plan
Waste	C	C	B	D	Groups 1 & 2: Management plan must be prepared for collection and disposal of construction wastes generated during rehabilitation and new construction works Group 3: In addition to the above comment a management plan for the waste generated during the operation is also necessary
Natural Environment					
Hydrological situation	D	C	D	D	Group 2: Any effect of N1 on the adjacent Euphrates River must be considered in the route design and operation phases.
Flora and fauna	D	C	D	D	Group 2: The effect on the surrounding flora and fauna in the cases of lines N1 and N3 need to be considered
Landscape	D	C	D	D	Group 2: Stations associated with new lines should be designed so as not to conflict with surroundings
Pollution					
Air pollution	D	D	D	C	Group 4: The new rolling stock should be selected to limit air pollutant emissions
Water pollution	D	C	C	D	Group 2: Pollution of nearby rivers and groundwater during construction needs to be avoided. Group 3: In addition to the above comment the operation plan must also be prepared to avoid groundwater contamination
Noise and vibration	B	B	B	B	All the project groups will result in larger operation capacity and faster speeds, which will generate noise and vibration. These conditions must be considered in the design and operation standards and purchase of new rolling stock
Offensive odor	D	D	C	D	Group 3: Design and operation plans should consider ventilation and worker safety against odors generated during maintenance works in the new workshops.
Notes: Evaluation categories: A: Serious impact is predicted, B: Some impact is predicted, C: Extent of impact is unknown, examination is needed, D: No impact is predicted, EIA is not necessary					

In the case of GEHR projects there are valid environmental concerns surrounding the Hidjaz – Qaddam stations underground section of the Damascus – Daraa rehabilitation line, and the Airport railway project. These include protection of historic assets, land allocation problems,

and harmony in traffic management between the road traffic and the proposed new project sharing the same route. Results are given in Table 17.3.10.

Table 17.3.10 Scoping of Master Plan GEHR Projects

Environmental Item	Project 1	Project 2	Project 3	Project 4	Remarks
Social Environment					
Resettlement	D	D	D	B	Project 4: Airport railway line from Hidjaz station to the airport highway will require land allocation and resettlement
Traffic and public facilities	D	D	D	C	Project 4: Airport railway line will affect road traffic and must be completely segregated at crossings with the roads. Also stations of the new line will attract traffic and may affect the surrounding road traffic.
Split of communities	D	D	D	C	Project 4: Airport railway line shall be completely segregated and depending on route may split certain communities
Cultural property	C	D	C	C	Project 1: The historic stations along the Damascus – Daraa line must be protected during any rehabilitation works Project 3: The Bosra line rehabilitation route must take into consideration the ancient theater of Bosra Project 4: In the Hidjaz station area the antiquities above and under the ground should be considered
Waste	C	C	C	C	Projects 1 to 4: Management plan must be prepared for collection and disposal of construction wastes generated during rehabilitation and new construction works, taking into consideration nature of the wastes.
Hazards (risks)	D	D	D	C	Project 4: New airport line crossings with the road traffic must be well designed and operated to avoid accidents
Natural Environment					
Topography and geology	C	D	D	D	Project 1: Effect of large scale excavation for tunnel needs to be studied further
Groundwater	C	D	D	C	Project 1: Effect of large scale excavation for tunnel needs to be studied further Project 4: New airport line structures in urban area my involve excavation and affect groundwater
Hydrological situation	D	C	D	D	Project 2: Rehabilitation plan for Surghaya line must protect the adjacent river
Landscape	D	D	D	C	Project 4: New airport line structures in urban may affect the urban landscape
Pollution					
21. Noise and vibration	B	B	B	B	All the project groups will result in larger operation capacity and faster speeds, which will generate noise and vibration. These conditions must be considered in the design and operation standards.
Notes: Evaluation categories: A: Serious impact is predicted, B: Some impact is predicted, C: Extent of impact is unknown, examination is needed, D: No impact is predicted, EIA is not necessary					

17.4 Overall Evaluation

(1) Environmental Impact Assessment Requirement

EIA is required for the following projects of the master plan at the time of detailed design:

1) GESR:

- Construction of new lines; Eight projects
- Construction of Workshops (including Depots); Three projects

2) GEHR:

- Construction of underground section between Hidjaz and Qaddam stations
- Construction of new Airport line

(2) Environmental Issues associated with New Line Projects

GESR has already developed plans for new lines, which have been adopted in this Master Plan. Some of the projects have actually started. No environmental studies were done in association with these projects. Four issues should be studied in the EIA for new lines; railway option viability, route selection, construction implementation and operation plan.

1) Railway Viability

Compared to road transport, rail transport provided a more environmentally friendly transport mode, as shown in Table 17.4.1.

Table 17.4.1 Rail and Road Comparative Transport Characteristics

Characteristic	Rail		Road	
Energy efficiency	High if well loaded		High for buses, low for cars	
Use of land resources	Narrow but not very flexible		Wider but more flexible	
Noise	Loud but nearby only, intermittent		Moderate but common and continuous	
Air pollution	Low		Medium/ high	
Passenger (g/pax-km)	Diesel	Electric	Car	Bus
CO^2	80	80	150	40
Nox	1.5	0.5	2.0	1.0
SO^2	0.2	1.0	0.05	0.1
CO	0.2	0.02	10.0	0.5
HC	0.1	0.001	1.5	0.1
VOC	0.5	0.001	2.0	0.5
Freight (g/ton-km)	Diesel	Electric	Truck	Trailers
CO^2	40	40	250	100
Nox	0.7	0.2	4.0	3.0
SO^2	0.1	1.0	0.3	0.2
CO	0.15	0.01	2.0	0.2
HC	0.1	0	0.5	0.3
VOC	0.1	0.01	1.0	NA
Source: The Environmental Impact of Railways, T. G. Carpenter, 1994				

2) Route Selection

Four main environmental issues on routing should be checked in the EIA process:

- Avoidance of valuable features of heritage, habitat or landscape
- Avoidance of population centers not served by the new line
- Taking into account existing regional development and land use plans
- Making use of existing transport corridors (roads, railways, canals, etc.) or sharing corridors with newly planned roads

3) Operation Plan

The adopted operation plan may have positive impact on the environment. Examples are as follows:

- Electrification of the line would provide more positive impacts than diesel locomotive operation in terms of reductions in use of fuel resources, air pollution emissions and noise. However electrification of the line should be considered in tandem with the traffic demand because of the associated investment costs.

- Increase in carrying capacities and speeds would increase competitive edge of the railway over the road alternative.

- Introduction of combined transport freight between road/rail transfer stations relying more on containers and modernized loading/unloading facilities will also attract more freight transport to the more environmental friendly rail mode and lower dependence on truck transport.

- Improvement of rail passenger transport through operation under suitable time schedules, provision of more comfortable passenger coaches, and more user-friendly stations.

4) Design and Construction of New Line

The design of the new line should take into consideration limiting the environmental impacts as much as possible, such as minimization of land acquisition, reduction of

noise through noise barriers erection, reduction of effect on landscaping and taking adequate measures to ensure worker and property safety during construction.

Construction involves having large numbers of people and equipment working on the project. Access to the construction sites has to be maintained for manpower, provision of construction materials and equipment. Some construction activities and their potential environmental impacts to the workers and surrounding environment are as follows:

- Land acquisition and clearance: Social impact is severe and this step requires social survey and provision of necessary compensations under the regulations.

- Earthworks and tunnels: Environmental impacts include landscape and visual impacts, dust, land settlement and working on hazardous ground.

- Structures: Pollution of land and water and generation of noise.

- Construction traffic: Noise generation, delays and congestion in roads, rail and pedestrians traffic and accidents generation.

Chapter 18 Conclusion and Recommendation

18.1 Conclusion

18.1.1 GESR

(1) Outline of the Master Plan and Staged Development Plan

A master plan for the development of Syrian Railways has been drawn up with the target year of 2020. In order to realize the master plan, staged development plans of a short term (2005), medium term (2010), and long terms (2015 and 2020) have also been drawn up, based on the study having been made regarding the order of priority of investment for the projects which constitute the master plan, such as the rehabilitation and modernization of existing facilities and new line construction projects of GESR.

(2) Rehabilitation and Modernization of Existing Facilities of GESR

The rehabilitation and modernization of the existing railway facilities has been planned, with the aim of ensuring safe and stable transport with the minimum amount of investment possible. The rehabilitation and modernization projects are shown in Table 18.1. An outline of the major contents of these rehabilitation and modernization projects is as follows.

① An adequate train operation system will be established, and facilities for ensuring train operation safety (such as signal facilities) will be reinforced.

② Such measures as the new construction of signal stations and double tracking will be taken, in order to operate the necessary number of trains for meeting the transport demand, and also to ensure track capacity which enables the increase in the number of trains.

③ Rolling stock will be additionally introduced according to the train operation plan and based on the transport demand.

④ Rolling stock maintenance workshops will be modernized, in order to enhance the

productivity of rolling stock.

⑤ Tracks and level crossing facilities will adequately be established or reinforced, taking into consideration such factors as the speedup of trains and increase in the number of trains.

⑥ As for the telecommunication facilities, optical fiber cables will be laid, and telecommunication systems centering on the optical fiber electric transmission system will be established.

⑦ As for the freight services which will still be a basic elements of commercial activities in the future, a freight information system will be established by utilizing the optical fiber electric transmission system which is to be separately developed, in order to enhance the railway reliability to consignors and to improve the railway into a user-friendly one. The freight information system to be newly established will aim at the correct forecast of the arrival date and time of freight; administration of the results of freight transport; and so forth.

⑧ As for the passenger services, improvement of train operation will be made in order to satisfy the demand of users, such as the enhancement of their convenience. The main measures to be taken include the increase in the train operation frequency during daytime by introducing diesel car trains; and the operation of locomotive-hauled sleeper car trains.

The staged development plans of the rehabilitation and modernization of existing facilities projects are also shown in Table 18.1. This table was prepared based on the results of consultation with the Syrian side with due consideration on priority of the projects, international traffic and efficiency of project implementation. In giving priorities to the projects, comprehensive evaluation has been made from various aspects, such as benefit/cost aspect, socio-economic factors, number of trains, railway facilities, and the priority rank which the Syrian side is giving.

Table 18.1 Staged Development Plan
(Rehabilitation and Modernization of Existing Facilities)

No.	Project	Short-term	Medium-term	Long-term	
		2001～2005	2006～2010	2011～2015	2016～2020
1	Midan Ekbas ～Aleppo				
2	Aleppo～Damascus				
3	Aleppo～Lattakia				
4	Lattakia ～Tartous				
5	Tartous ～Homs～Mhine～Al Sharqia				
6	Aleppo ～Deir el-zor				
7	Deir el-zor～Qamishli				
8	Qamishli～Al Yaroubiye				
9	Loco Workshop				
10	Aleppo PC Workshop				
11	Jublin FC Workshop				
12	Freight Information system				
13	Rolling stock procurement				

Legend :

- Substantial Work
- Auxiliary Work
- Signal and telecommunication facilities improvement already committed
- Signal station construction or double tracking conducted to cope with the shortage of the shortage of track capacity due to the increase traffic demand

(3) New Line Construction of GESR

Establishment of the railway network shown in Fig 18.1 has been planned, taking into consideration such factors as the international transport between Syria and neighboring countries, and well balanced transport routes within Syria.

Main projects of new line construction are the construction between Deir el-zor and Al Bukamal (about 145km); one between Damascus and the Jordan border (about 100km); and one between Al Sharqir and Deir el-Zor (about 240km). New line construction projects of GESR are shown in Table 18.2.

The staged development plans of the new line construction projects are also shown in Table18.2.

This table was prepared based on the results of consultation with the Syrian side with due consideration on priority of the projects, and efficiency of project implementation. In giving priorities to the projects, comprehensive evaluation has been made from various aspects, such as benefit/cost aspect; socio-economic factors, number of trains, railway

network planning and the priority ranks which the Syrian side is giving.

Table 18.2 Staged Development Plan (New Line Construction)

No.	Project	Short-term	Medium-term	Long-term	
		2001～2005	2006～2010	2011～2015	2016～2020
1	Deir el-zor ～Al Bukamal	■			
2	Damascus～Kiswa	■			
	Kiswa～Jordan Border		■	═	═
3	Al Sharqia～Tadmor～Deir el- zor	■	■	┅	┅
4	Adra ～Kabon	■			
5	Maarret Ikhwan ～Edlab	■	■	■	
6	Akkari～Lebanon Border	■			
7	Kadam～Hidjaz station	■	■		
8	West Entrance to Aleppo		■		
9	Rolling stock Procurement	■	■	■	■

Legend :

■ Sabstantial Work

═ Auxiliary Work

┅ Signal station construction to cope with the shortage of track capacity due to the increase traffic demand

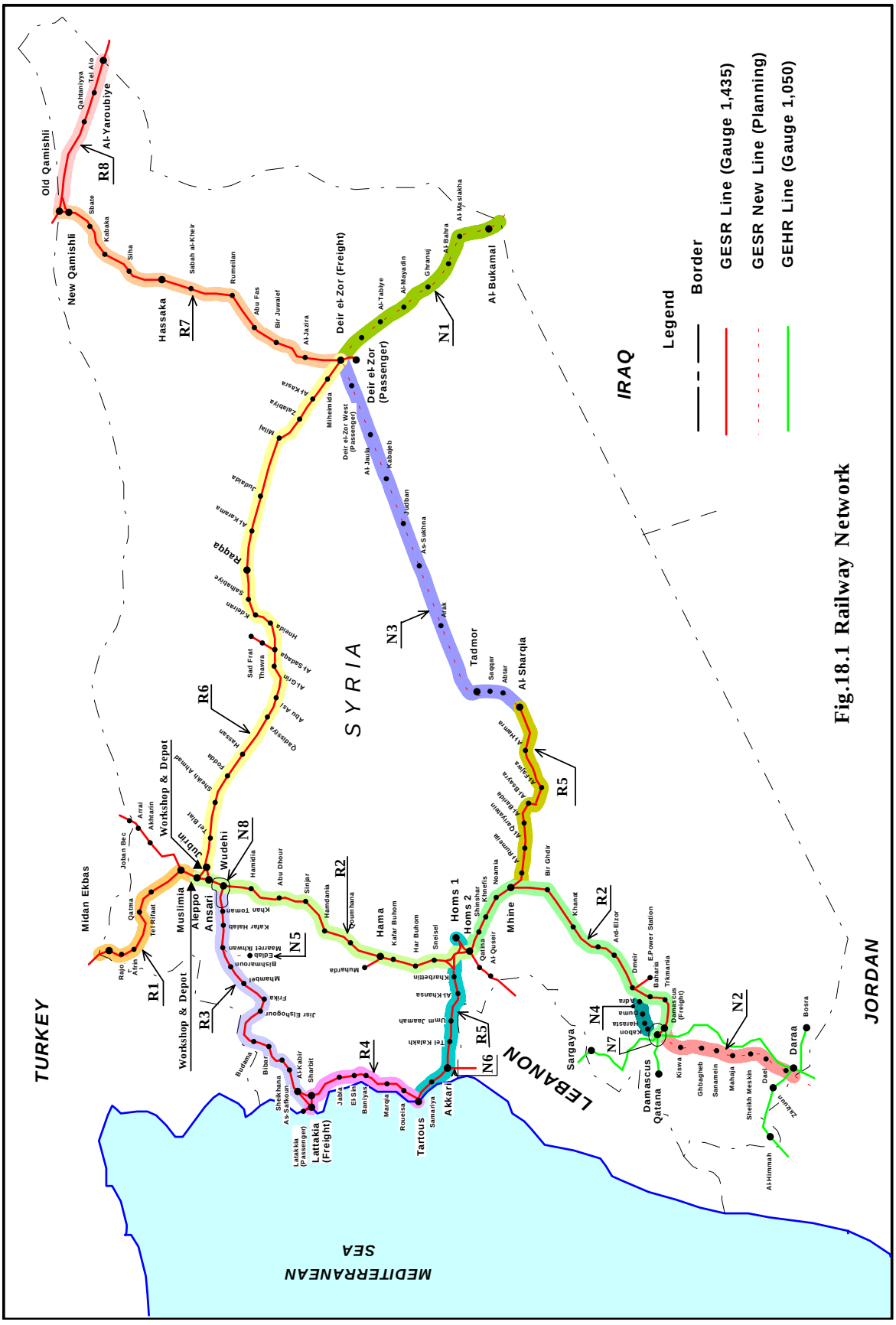

Fig.18.1 Railway Network

18.1.2 **GEHR**

The main roles of the current GEHR lines are expected to be the urban transport in Damascus City including Damascus Airport Line operation and transport of pilgrims and tourists. However, in the Study, urban transport projects including Airport line have been excluded. As such, rehabilitation of the existing line has been mainly studied.

GEHR is now seriously planning to modernize its railway system through gauge conversion from the current meter gauge to the standard gauge, the same gauge as that of GESR.
Its major plans are as follows:

(1) Construction of Damascus Airport Line
(2) Construction of standard gauged line between Kadam and Jordan Border

The advantages of such conversion will be (1) to be able to integrate GEHR and GESR into the same gauged unified railway network all over Syria, and (2) to promote intra-and inter-regional railway transport.
However, because conversion to standard gauge from meter gauge requires considerable amount of investment, it must be carefully examined from the view point of national economy and financial viability of railway enterprise. Bearing in mind the above discussion, and because the gauge conversion is not yet justified from the economic and financial view point, JICA Study Team has presented the improvement plan of existing lines with minimum investment to ensure the operation safety. However, gauge conversion can be programmed as soon as its economic and financial justification can be ensured. JICA Study Team presented its views on modernization of GEHR through gauge conversion.

Table 18.3 shows the GEHR projects for improvement of existing lines which are based on the results of the consultation with the Syrian side. As shown in the table, the projects of GEHR are mainly composed of rehabilitation projects. However, the economic and financial analysis has not been carried out and only works with the minimum investment have been planned for these rehabilitation projects which mainly aimed at the betterment of tracks, level crossings, and signal and telecommunications facilities. In this case, the history and main roles of GEHR, as well as the present situation of the facilities have been taken into consideration, and great emphasis has also been placed on safety in train operation.

Table 18.3 GEHR Projects (Improvement of existing lines)

No.	Project	Priority Ranking	Priority Order	Remark
1	Rehabilitation of Darra line and Construction of Kadam-Hidjaz station	A	1	
2	Rehabilitation lf Surgaya line	A	2	
3	Rehabilitation of Qatana line and other lines	B	3	
4	Damascus- Airport	(A)		These projects are not included in the rehabilitation program of Master Plan, but only related discussion has been provided.
5	Tramway			

18.1.3 Conclusion

(1) GESR

The total amount of investment in the GESR projects under the master plan is about SP 171 billion.

The FIRR (Financial Internal Rate of Return), which evaluates GESR's master plan for 2020 and the phased development plans from the standpoint of enterprise business operation, is 2.0 %. Low interest rate loans and governmental assistance will be necessary for GESR to achieve a sound financial state.

However, the EIRR (Economic Internal Rate of Return), which evaluates the plans from the standpoint of the national economy, is 16.9 %. This is more than 12%, the opportunity capital cost of Syria. Therefore, it can be judged that the plans are feasible in terms of the national economy.

GESR recognizes the national and economic significance of the railway as an important infrastructure for social and economic activities in this country, and is trying to make the railways to play the adequate roles by receiving necessary financial assistance from the Government.

In this respect, the operation of trunk railways in Syria should not be judged only from the financial viewpoint, but should be evaluated also from the viewpoint of the national economy.
It has a large significance to make appropriate utilization of railway transport in view of the global problem of environmental destruction by automotive exhaust gas and the efficient energy consumption.

Furthermore, in the stage of actually implementing each project which constitutes the master plan, although each project is technically feasible, it is necessary to reduce the amount of investment as much as possible, by analyzing and studying in further detail the contents of the investment of the project, and also by considering environmental preservation. This will serve for the improvement of the financial aspect of the master plan.

As described above, the implementation of master plan of GESR can be justified for the sound development of social and economic activities of Syria. Therefore, the first step toward its implementation should be taken as soon as possible.

As it could be seen from the Table 18.4, total amount of investment for Master Plan may be afforded by Syrian economy in view of its future development.

However investment amount is very much concentrated in the first 5 years. In this regard it is suggested to consider that execution period of some projects in the first 5 years may be extended and investment amount in the each 5 years period may be leveled off. In this way Master Plan's economic and financial feasibility will be more improved.

Table 18.4 Master Plan Investment for Each 5 years

million SP.

Year	Short-term	Medium-term	Long-term		Total
	2001 - 2005	2006 – 2010	2011 - 2015	2016 – 2020	
Estimated Affordable Budget of GESR (*)	27,342	44,501	48,617	48,809	169,269
Master plan investment (* *)	64,575	36,366	35,668	29,452	166,061

(*) Refer to Table 6.3.3 (Budget includes estimated value for 2001)
(* *) Refer to Table 14.2. Engineering cost (5,405 million SP) is excluded.

(2) GEHR

(a) Role of GEHR

Role of GEHR should be promoted in close cooperation with related Agencies and GESR and with due consideration on practical investment.

- Tourism promotion
- International transport with Jordan and Lebanon
- Possibility to contribute to Damascus urban transport in future including airport access line

(b) Gauge Conversion

GEHR is now seriously planning to modernize the existing lines through gauge

conversion from meter gauge to standard gauge. Gauge conversion to standard gauge has merits of integrating all Syrian railway network into unified gauge network and of promoting international transport. However, since it needs considerable investment cost, and economic justification of gauge conversion is not yet confirmed, improvement of existing meter gauge track with minimum investment has been proposed in the Report.

(c) Improvement of existing lines

Related with tourism and international transport, minimum necessary investment for safe train operation for the 1st and 2nd priority projects (1,677 million SP) should be considered in the first place. Later investment for 3rd priority project (443 million SP) should be considered. At the same time, railway management and staff training should be improved. In case economic feasibility of gauge conversion to standard gauge will have been confirmed, improvement of existing railway can be switched to modernization of railways through gauge conversion to standard gauge.

(3) Software Aspects

For the effective implementation of the master plan, it is essential to make improvement in software aspects (administration and operation, marketing policy, maintenance technology, employee education, etc.), in addition to the improvement in hardware aspects (facilities, rolling stock, etc.).

The improvement measures in the software aspects are summarized in item 18.2 (Recommendation), and the details are described in the respective chapters concerned.

18.2 Recommendation

18.2.1 **GESR**

(1) Ensuring of railway reliability (Punctual train operation)

In the case where departure and arrival times of passenger trains and freight trains are uncertain, railway users will lose confidence in the railway and will eventually use other means of transport.

As a matter of course, it is necessary at first to prevent troubles of locomotives, tracks, signals and so forth, because most cases of train delay are caused by such troubles. However, when a trouble has occurred, it is essential to try to ensure punctuality of train operation as much as possible by adequately arranging the personnel for early restoration and by securing spare materials. Sufficient maintenance of facilities in usual time is also important.

For stable train operation, it is necessary to establish adequate organizations and systems so that the train dispatchers can sufficiently grasp the delay of trains and so forth, to investigate the cause of the delay, and to comprehensively promote countermeasures from both software and hardware aspects. Especially, measures against the delay of trains caused by software reasons such as train operation handling should urgently be implemented.

The ensuring of railway reliability will lead to the increase in railway passenger and freight traffic volume.

(2) Ensuring of convenience for railway users

1) Passenger transport

It is necessary to operate passenger trains which are convenient for and can satisfy the need of passengers by the phased reinforcement of transport capacity in accordance with the demands. Specifically, it is needed to take such measures as the frequent operation of short-consist trains in daytime; and the operation of night trains with appropriate departure and arrival times. At the same time, service quality should be

enhanced in such respects as the guidance for passengers and ticket vending at stations.

2) Freight transport

As for the freight trains, it is essential to establish appropriate marketing systems which ensure easy railway utilization by consignors. For instance, the trains to be regularly operated should be clarified by drawing up train diagrams, and a proper system of connecting loaded freight cars between trains should be established. Then, accurate forecast of the arrival date and time should be made when the railway accepts freight for transport, and the information should be conveyed to the consignor.

Furthermore, it is recommendable to accumulate various kinds of information by utilizing the freight information system which is scheduled to be developed separately under the master plan in the future. Then, based on such data, freight transport services should be further improved to enhance the convenience for consignors in such respects as the operation of freight cars. Moreover, efforts should be made to reduce the freight distribution cost by such measures as the modernization of loading and unloading systems.

(3) Maintenance of railway facilities

As described before, it is important for safe train operation to carry out adequate maintenance of rolling stock and facilities in usual time. The measures which require urgent implementation are correction of rail joint depression; aligning of turnouts; improvement of level crossing facilities; restoration of signal and telecommunication facilities which are out of order, rehabilitation/modernization of rolling stock workshops; and so forth.

As for the maintenance in the future, it is necessary to conduct data-based maintenance of rolling stock and facilities and to establish and steadily implement rational maintenance plans.

At first, it is needed to arrange registers, such as track maintenance registers. Then, it is necessary to conduct systematic inspection and accumulate relevant data in the registers. Therefore, a reasonable maintenance plan should be established on the basis of these statistical data and from the standpoint of preventive maintenance. Lastly, the maintenance

plan thus established should be steadily put into practice, in order to ensure functions of railway facilities.

At the same time, it is necessary to establish a mechanism which can ensure early restoration after the occurrence of a trouble.

As for the sand damage typically seen between Deir el-Zor and Hassaka, great efforts are being made to carry out normal train operation and track maintenance. However, regarding the large-scale sand damage, it is necessary for entire GESR to study adequate countermeasures (tree planting, sand barrier fence, etc.) by utilizing know-how accumulated in field organizations, and with cooperation of external institutions, and to steadily put these measures into practice for a long period.

(4) Management and Training

Strong assistance has been provided for GESR by the Syrian Government, and there is no fear concerning the fund procurement. However, it is necessary for GESR to make efforts to improve its business operation performance (revenues and expenses) and reduce financial burden of the Government, by such measures as the improvement of facilities; adequate positioning of employees; and promotion of activities for increasing revenue.

As a matter of course, the enhancement of work productivity of employees by multi-functional work execution will become important in the course of the modernization of rolling stock maintenance workshop and railway facilities. As for the organizations, on the other hand, it is necessary to study and revise the officially designated number of personnel. For instance, in carrying out such measures as the reduction of the number of station personnel by introducing CTC, it is essential to secure the necessary number of personnel in some fields of specialty which are in shortage of experts, by revising the designated number of station personnel and promoting job-transfer training.

With the progress of modernization of rolling stock and railway facilities, new technological strength will become necessary. In introducing new technologies, therefore, it is needed for GESR to request the suppliers of the technologies to supply teaching materials for training schools at the same time, so that employees can obtain new technologies at the training schools and adequate train operation handling and sufficient

maintenance of railway facilities can be ensured. Furthermore, another measure advisable is the dispatch of employees to oversea countries for undergoing training, or the execution of training in Syria by inviting instructors from abroad.

As for the reinforcement of technical power of employees, ensuring of safe transport and so forth, there are some recommendable measures for steadily enhancing quality of employees, such as systematic execution of on-the-job training; establishment of new correspondence courses and so forth; in addition to the intensive training in training schools.

(5) Principle for promoting the projects in the future

For ensuring the successful implementation of the master plan, the following measures are recommended as ones which require urgent execution.

As for the GESR projects to be started in the 1st stage (short-term: 2001-2005), a feasibility study should be made for the Rehabilitation and Modernization of Existing Facilities projects and the new line construction projects. Then, after the confirmation of their feasibility, fund procurement and construction works should be started.

Investment amount in the first 5 years seems very large compared with that of other 5 years period. It is suggested to consider that execution of some projects in the first 5 years may be prolonged and investment amount of each five years may be leveled off.

As for the tasks in software aspects, necessary measures should be taken, starting from those practicable, by obtaining advice from experts of foreign countries which are advanced in railway technology and also by making internal analysis within GESR.

18.2.2 **GEHR**

(1) Gauge conversion

As a measure for promoting the development of GEHR, there is a method of enabling railway modernization by converting the track gauge from the present 1,050mm to 1,435mm. However, since this method requires a large amount of investment, it is advisable to convert the existing meter-gauge railway tracks into standard-gauge ones after

sufficiently analyzing the demand, profitability, and so forth.

(2) Ensuring of safety in train operation (Improvement of existing lines)

The GEHR projects are aiming at the development of tracks, level crossings, and signal facilities, and emphasis is placed on the safety in train operation. Therefore, it is recommendable for GEHR to study and implement concrete measures which can be realized at smallest amount of investment possible. These measures should urgently be taken, starting from those practicable.

To say nothing of the importance of safety training for employees, utmost efforts should also be made to prevent accidents. Effective preventive measures should urgently be established, on the basis of through analysis of past accidents including the probe into their causes. At that time, it should be sufficiently recognized that accident prevention cannot be perfectly realized by the dependence on human attentiveness alone.

In case economic feasibility of gauge conversion to standard gauge will be confirmed, rehabilitation/modernization of existing lines of meter gauge can be switched off to that through gauge conversion to standard gauge.

(3) Urban railway transport

GEHR is playing a role in local tourism. Another role of GEHR is the urban railway transport in Damascus City. In planning urban railway projects, it is necessary for GEHR to hold sufficient consultations with Damascus City, so that the projects can fully be coordinated with urban development plans and road transport. Furthermore, it is also advisable for GEHR to obtain financial assistance from the Government and Damascus City for realization of the projects.

(4) Management and Training

In recent years, GEHR has been placing emphasis on railway sectors. Therefore, it is necessary to expand the transport division of GEHR carefully, taking into consideration the profit produced by the real estate division and so forth. It is also important to pay attention to the control of personnel cost and other expenses. The deficit of the transport division should be kept strictly within the amount which can be covered by the total profit of other divisions.

At present, personnel education in GEHR is depending on on-the-job training. For highly specialized railways, however, systematic training on such items as technology, safety, and customer service should be made. For this purpose, it is considered advisable for GEHR to entrust its personnel training to the GESR training institutions which have sufficient education facilities and instructors.