Japan International Cooperation Agency (JICA)
Syrian Arab Republic

No.

The Master Plan Study on the Development of Syrian Railways in the Syrian Arab Republic

Volume I

Development of Phased Rehabilitation and Modernization Plan for the year 2005, 2010 and 2020

Final Report
(Summary)

August, 2001

Japan Railway Technical Service (JARTS)
Yachiyo Engineering CO., LTD. (YEC)

SSF
JR
02- 120 (4/6)

Exchange Rate of Currency

1 US$ = 46 Syrian Pounds

1 US$ = ¥106

1 Syrian Pound = ¥2.3

June, 2000

PREFACE

In response to a request from the Government of the Syrian Arab Republic, the Government of Japan decided to conduct a Master Plan Study on the Development of Syrian Railways in the Syrian Arab Republic and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Dr. Sadaaki Kuroda of Japan Railway Technical Service, and consist of Japan Railway Technical Service and Yachiyo Engineering Co., Ltd. to the Syrian Arab Republic, 3 times between April 2000 and August 2001.

In addition, JICA set up an advisory committee headed by Mr. Hiroshi Saeki, Director, Environmental Office, Railway Bureau, Ministry of Transport (present Ministry of Land, Infrastructure and Transport) between April 2000 and August 2001, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of the Syrian Arab Republic and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Syrian Arab Republic for their close cooperation extended to the Team.

August 2001

Kunihiko Saito
President
Japan International Cooperation Agency

August, 2001

Mr. Kunihiko SAITO
President
Japan International Cooperation Agency

Dear Sir,

Letter of Transmittal

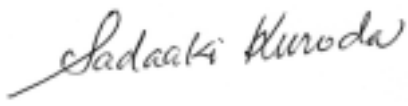
We have the pleasure of submitting herewith our Report for the Master Plan Study on the Development of Syrian Railways in the Syrian Arab Republic. The report describes the results of the Study carried out by Japan Railway Technical Service and Yachiyo Engineering Co. Ltd., as per the contract with Japan International Cooperation Agency.

The Study Team conducted field surveys three times during the period from April 2000 to August 2001. The Team held sufficient consultations with the Syrian governmental agencies concerned regarding the results of the field surveys and study activities in Japan, and drew up a master plan for the rehabilitation and modernization of the nationwide railway for the year 2020; phased rehabilitation and modernization plans for 2005 (short term), 2010 (medium term), and 2020 (long term); and two plans, as short-term urgent projects, on the rehabilitation and modernization of Tartous, Homs and Al-Sharqia section and on the locomotive workshop modernization. In close coordination with the Syrian side, the Team thereafter studied the feasibility of these plans from technical, environmental, economic, and financial aspects, and drew up this report.

From the standpoint of reinforcing the transport infrastructures necessary for the social and economic development of Syria, we would like to recommend the early implementation of the two projects: rehabilitation and modernization of the railway section between Tortous, Homs and Al-Sharqia; and locomotive workshop modernization.

We wish to express our sincere gratitude to the Japan International Cooperation Agency, the Ministry of Foreign Affairs, the Ministry of Land, Infrastructure and Transport, and the Japanese Embassy and JICA Office in Syria for the kind assistance and guidance extended to us in executing the Study.

Yours faithfully,



Sadaaki KURODA, Dr. Eng.
Leader
The Study Team for the Master Plan Study on the Development
of Syrian Railways in the Syrian Arab Republic

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RUSSIA
ARMENIA
AZERBAIJAN
TURKMENISTAN
IRAN
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ISRAEL
JORDAN
KUWAIT
SAUDI ARABIA
QATAR
UNITED ARAB EMIRATES
EGYPT
LIBYA
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SAHARA
LIBYAN DESERT
AN NAFŪD
NAJD
AEGEAN ISLANDS
Aegean Sea
Mediterranean Sea
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Salonica
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Larisa
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Kars
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Ganca
Lamia
Patras
Eskişehir
Ankara
Kırıkkale
Sivas
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Erzurum
Naxçıvan
Xankändi
İzmir
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Kırşehir
Kayseri
Elâzığ
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Van
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Denizli
Isparta
Muğla
Antalya
Konya
Malatya
Diyarbakır
Hakkâri
Tripolis
Kalámata
Adana
Mersin
Gaziantep
Antakya
Aleppo
Idlib
Hamāh
Homs
Tripoli
Beirut
Damascus
As Suwaydā
Haifa
Tel Aviv-Yafo
Jerusalem
Ammān
Iráklion
Limassol
Dayr az Zawr
Mosul
Arbīl
As Sulaymānīyah
Baghdad
Al Hillah
An Najaf
Al 'Amārah
An Nāşirīyah
Basra
Mīāneh
Rasht
Zanjān
Qazvin
Karaj
Tehrān
Āmol
Sārī
Gorgān
Bojnūrd
Sanandaj
Hamadān
Qom
Kāshān
Kermānshāh
Īlām
Borūjerd
Khorramābād
Eşfahān
Dezfūl
Ahvāz
Behbahān
Kāzerūn
Shīrāz
Yazd
Sīrjān
Dārāb
Jahrom
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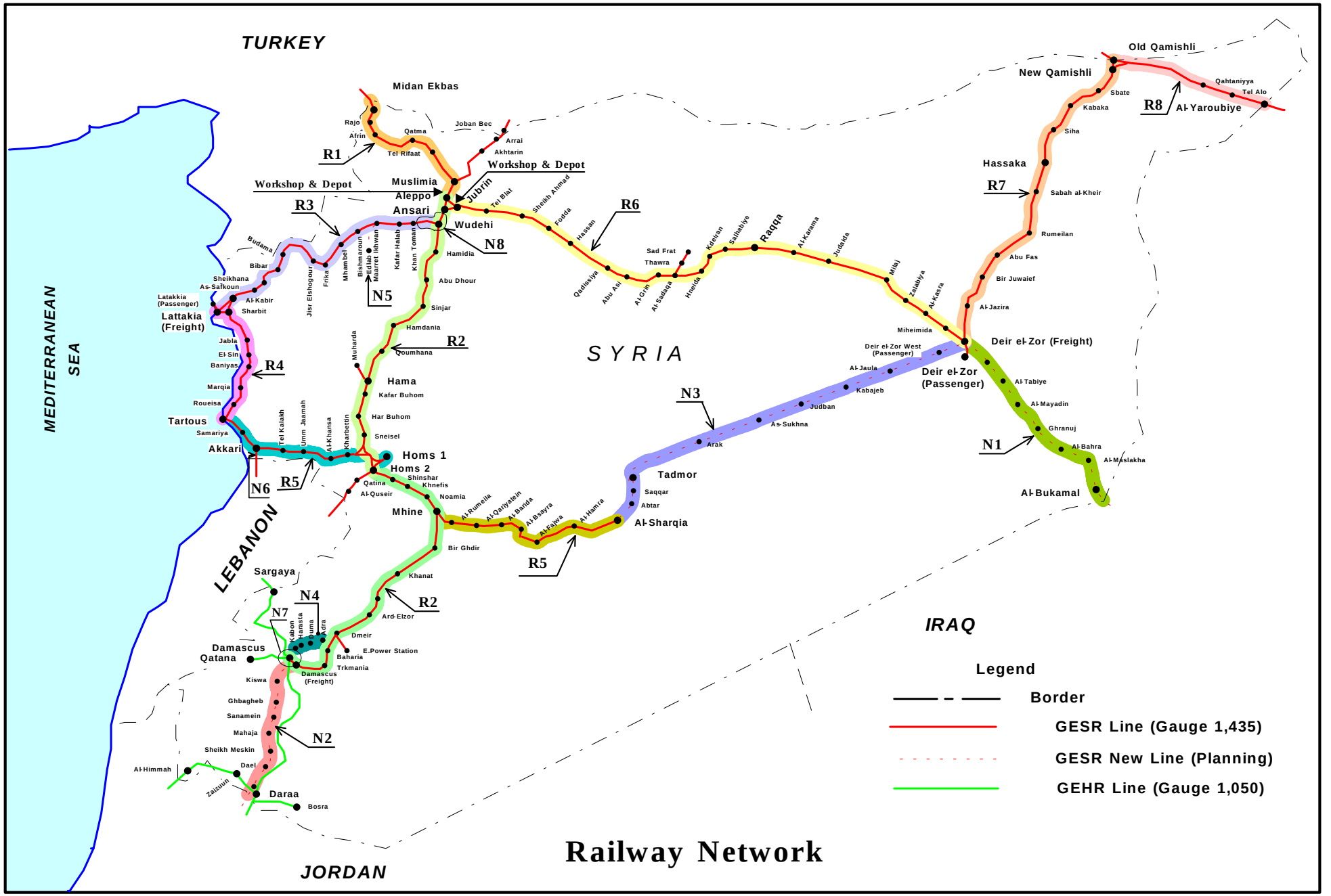
TURKEY
SYRIA
LEBANON
IRAQ
JORDAN
MEDITERRANEAN SEA
Midan Ekbas
Rajo
Afrin
Qatma
Tel Rifaat
Joban Bec
Arrai
Akhtarin
R1
Workshop & Depot
Muslimia
Aleppo
Ansari
Jubrin
Workshop & Depot
R3
Wudehi
N8
Budama
Bibar
Sheikhana
As-Safkoun
Latakkia (Passenger)
Lattakia (Freight)
Al-Kabir
Sharbit
Jisr Elshogour
Frika
Mhambel
Bishmaroun
Edlab
Maarret Ihwan
Kafar Halab
Khan Tomane
Hamidia
Abu Dhour
Sinjar
N5
Hamdania
R2
Qoumhana
Muharda
Hama
Kafar Buhom
Har Buhom
Sneisel
Homs 1
Homs 2
Shinshar
Khnefis
Noamia
Mhine
Qatina
Al-Quseir
Jabla
El-Sin
Baniyas
R4
Marqia
Roueisa
Tartous
Samariya
Akkari
N6
R5
Tel Kalakh
Umm Jaamah
Al-Khansa
Kharbetiin
Sargaya
N4
N7
Kabon
Hamasta
Duma
Kafra
Damascus
Qatana
Damascus (Freight)
Trkmania
Baharia
E.Power Station
Dmeir
Ard-Elzor
Khanat
R2
Bir Ghdir
Kiswa
Ghbagheb
Sanamein
Mahaja
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Dael
Al-Himmah
Zaizuun
Daraa
Bosra
N2
Tel Biat
Sheikh Ahmad
Fodda
Hassan
R6
Qadissiya
Abu Asi
Al-Grin
Al-Sadaqa
Hneida
Sad Frat
Thawra
Kdeiran
Salhabiye
Raqqa
Al-Karama
Judada
Mihaj
Zalabiya
Al-Kasra
Miheimida
Deir el-Zor West (Passenger)
Deir el-Zor (Passenger)
Deir el-Zor (Freight)
Al-Jaula
Kabajeb
Judban
As-Sukhna
Arak
N3
Tadmor
Saqqar
Abtar
Al-Sharqia
Al-Rumeila
Al-Qariyatein
Al-Banida
Al-Bsayra
Al-Faiwa
Al-Hamra
R5
Old Qamishli
New Qamishli
Sbate
Kabaka
Siha
Hassaka
R7
Sabah al-Kheir
Rumeilan
Abu Fas
Bir Juwaief
Al-Jazira
Qahtaniyya
Tel Alo
R8
Al-Yaroubiye
Al-Tabiye
Al-Mayadin
Ghranuj
N1
Al-Bahra
Al-Maslakha
Al-Bukamal
Legend
Border
GESR Line (Gauge 1,435)
GESR New Line (Planning)
GEHR Line (Gauge 1,050)
Railway Network

Diesel Car Train Passing through the Bridge

The Master Plan Study on the Development of Syrian Railways in the Syrian Arab Republic

Volume Ⅰ

Development of Phased Rehabilitation and modernization Plan for the year 2005, 2010 and 2020.

(Executive Summary)

Study period : April 2000- August 2001
Accepting Organization: Ministry of Transport

1. Objective of the Study

(1) Development of Phased Rehabilitation and Modernization Plan of GESR and GEHR for the Year 2005, 2010 and 2020 (Master Plan)
(2) Feasibility Study of the Urgent Short Term Project Selected from Master Plan
(3) Technology Transfer Through the Study Activities

2. Study Method

The study team conducted on-site surveys in order to obtain an understanding of the actual situations in Syria. It exchanged views with the Syrian Steering Committee, Managing Committee and counterpart team, and collected relevant information. Based on the results of the survey in Syria and Japanese experiences, the study team drew up a report.

3. Outline of the Study

3.1 Outline of Master Plan and Staged Development Plan

(1) Staged Development plan

- Rehabilitation and modernization of Existing Facilities – (GESR)

12 projects for rehabilitation and modernization of existing facilities were set up together with rolling stock procurement, and priority was given to each project from the overall view points. Based on priorities thus established, staged development plan as shown in Table 3.1.1 was drawn up.

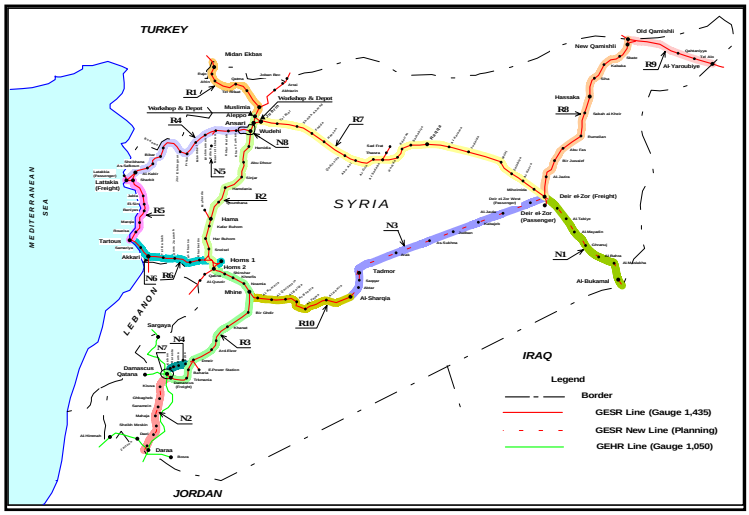


Fig 3.1 Railway Network

Table 3.1.1 Staged Development Plan (GESR)
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) Staged Development Plan (New Line Construction) (GESR)

8 new line construction projects were set up together with rolling stock procurement. Priority was given to each project based on overall view points. Based on the priority, staged development plan as shown in Table 3.1.2 was prepared.

Table 3.1.2 Staged Development Plan (New Line Construction) (GESR)

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

(3) Development plan of GEHR

Development projects for GEHR were established and given priority in consultation with GEHR. The projects and their priority given are shown in Table 3.1.3.

Table 3.1.3 Development Plan of GEHR

No.	Project Name	Priority Ranking	Priority Order	Remarks
1	Rehabilitation of Daraa line and Constructio of Kadam-Hidjaz station	A	1	To be studied together with GESR project
2	rehabilitation of Surgaya Line	A	2	
3	Rehabilitation of Qatana line and other lines	B	3	
4	Damascus-Airport	(A)		Not included in the cost/benefit analysis of Master plan projects but discussed in the report on non-quantitabive basis
5	Tramway			Not included in the cost/benefit analysis of Master plan projects but discussed in the report on non-quantitaative basis

3.2 Socio Economic Frame Work

Socio economic model was formulated for forecasting the future socio-economic framework. Major outputs by the model are given in Fig. 3.2.1.

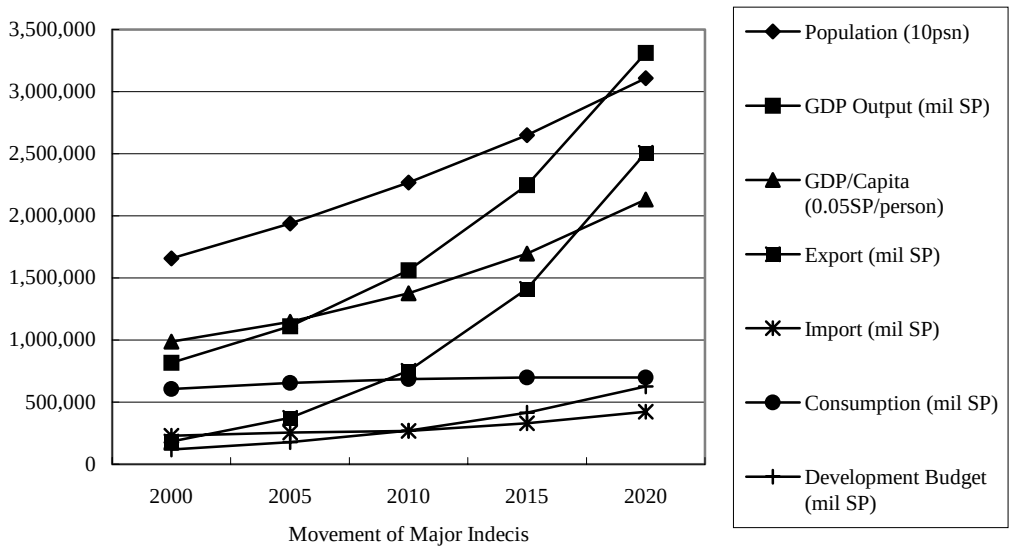


Fig. 3.2.1 Major Output from the Model

3.3 Demand Forecast

Demand forecast of passengers and freight by all transport modes and by railway are given in Fig.3.3-1 for each case of with-Master plan and without-Master plan (do nothing) case. Traffic volume by all modes are about 2.4 times for passenger and 5.0 times for freight in 2020 against those in 2000 while railway passengers and freight will be increased to 6.3 times and 6.9 times respectively in 2020 against those of 2000.

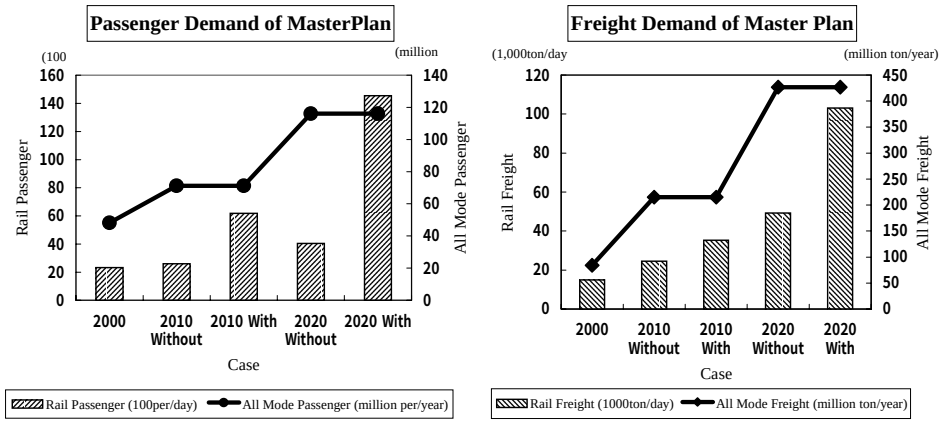


Fig. 3.3.1 Demand Forecast of Railway Traffic

Railway traffic shares are about 5% for passenger and about 9% for freight both in 2020 for with-Master plan case as shown in Fig 3.3.2.

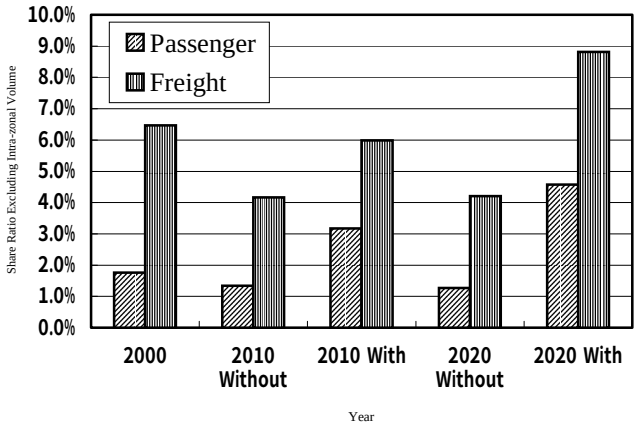


Fig. 3.3.2 Master Plan Modal Share of Railway

4. Evaluation of the Master plan

4.1 Economic and Financial Analysis of Master Plan

4.1.1 Economic Analysis

(1) Benefit

- Difference of [Road vehicle operation cost + Rail Operating Cost] between without-case and with-case
- Difference of rail and road travel time cost between without-case and with-case

(2) EIRR = 16.9%
Opportunity cost of capital in Syria = 12%
Master plan is economically feasible

4.1.2 Financial Analysis

(1) Fare and Rate
The same as the current prices
Freight = 0.8869 SP/ton-km
Passenger = 0.1755 SP/person-km

(2) FIRR = 2.0%

(3) Loan Condition

(a) Interest: 2.2% p.a.
Grace: 10 years
Repayment: 30 years semiannual equal installment

(b) Interest: 0.75%p.a.
Grace: 10 years
Repayment: 35 years From 11th ~20th year: 2.5% of total loan amount per year
From 21th~35th year: 5% of total loan amount per year

(4) In case the low interest loan such as the above can be borrowed from the international financial institution or foreign government and the government supports the local currency portion not covered by foreign loan, Master plan is financially feasible.

4.2 Natural Conditions and the Environment

(1) Environment Protection Law

New draft environment protection law requiring EIA is under consideration since 1994 both in parliament and presently in the cabinet of ministers.

At this time no clear legal requirement for EIA.

- This Study examines the environmental impact of the planned railway projects based on JICA guidelines
- Standards developed are on a provisional basis, and are not legalized yet.
  Developed Provisional Standards are for
- air quality
- potable water quality
- wastewater from industrial establishment

(2) Screening of Master Plan GESR Project

Project / Environmental Item	Rehabilitation	New Line Construction	Workshop Construction	Rolling Stock Procurement
Social Environment	D	A	B	D
Natural Environment	D	C	D	D
Pollution	B	B	B	B
Overall Evalation	C	EIA Necessary	EIA Necessary	C

Where:
A: Serious impact is predicted
B: Some impact is predicted
C: Extent of mipact is unknown and further examination is necessary
D: No impact is predicted, EIA is not necessary

(3) Screening of GEHR Project

Project / Environmental Item	Damascus〜Daraa Rehabilitation (including Hidjaz〜Qadam underground)	Surghaya Line Rehaibilitation	Qatana, Bosra Muzeireeb Lines Rehabilitations	Airport Railway
Social Environment	C	D	C	B
Natural Environment	C	D	D	C
Pollution	B	B	B	B
Overall Evalution	EIA necessary	C	C	EIA necessary

Where: A, B, C, D are the same definitions as (2) above.

5. Conclusion and Recommendation

5.1 GESR

(1) Master Plan Investment for Each 5 years

Year	Short-term	Medium-term	Long-term		Total
	2001-2005	2006-2010	2011-2015	2016-2020	
Estimated Affordable Budjet 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

(*) Budget includes estimated value for 2001

(**) Engineering cost (5,405million SP)is excluded.

Total amount of investment for Master Plan may be afforded by Syrian economy, but investment in the first 5years is suggested to be leveled off.

(2) Cost/Benefit Analysis of Staged Development Plan

EIRR = 16.9% (Basic case)

FIRR = 2.0% (Basic case)

Master plan is feasible from national economic point of view.

Master plan is financially feasible in case low interest international or foreign loan is available and government supports local currency portion not covered by foreign loan.

(3) Master plan should be implemented as soon as practical

(4) The followings should be promoted so that Staged Development Plan (Master plan) can be effectively realized.

① Ensuring of railway reliability (punctual train operation)
② Ensuring of convenience for railway users
③ Improvement of maintenance of railway facilities
④ Improvement of management and training

5.2 GEHR

(1) Role of GEHR

The following 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
- Possibility to contribute to Damascus urban transport in future including airport access line

(2) 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.

(3) 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 railways can be switched to modernization of railways through gauge conversion to standard gauge.

Master Plan Contents

PART I THE PRESENT SITUATION AND MAJOR ISSUES

PART II THE REHABILITATION/MODERNIJATION AND DEVELOPMENT PLAN

Abbreviation and Glossary

ADT	Average Daily Traffic
AOC	Administration and Operation Cost
ATP	Automatic Train Protection
ATS	Automatic Train Stop
B/C	Benefit Cost Ratio
BOD	Biochemical Oxygen Demand
CCITT (ITU-T)	International Telecommunication Union
CIF	Cost, Insurance and Freight
COD	Chemical Oxygen Demand
CONOCO	Continental Oil Company
CT	Closed Track Circuit
CTC	Centralized Traffic Control
DC	Diesel Car
DEL (LDE)	Diesel Electric Locomotive
DGMO	Director Generals of Middle East Railways
DHL	Diesel Hydraulic Locomotive
DL	Diesel Locomotive
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
FC	Freight Wagon
FIRR	Financial Internal Rate of Return
FS（F/S）	Feasibility Study
GCEA	General Council for Environmental Affairs
GDP	Gross Domestic Products
GEHR	General Establishment of Hidjaz Railways
GESR	General Establishment of Syrian Railways
GORS	General Organization of Remote Sensing
GRDP	Gross Regional Domestic Products
HID	High Intensity Discharge
HMIS	Highway Maintenance and Inspection System
HVAC	Heating, Ventilation and Air Conditioning
IEC	International Electro Technical Commission
IRI	International Roughness Index
ISO	International Standard Organization
JICA	Japan International Cooperation Agency
JR	Japan Railway

LED	Light Emitting Diode
MOF	Ministry of Finance
MOT	Ministry of Transport
MP（M/P）	Master Plan
MRT	Mass Rapid Transport
NDP	Net Domestic Products
NEAP	National Environmental Action Plan
NEEDS	Nikkei Economic Evaluation Data System
NPV	Net Present Value
OD	Origin-Destination
OJT	On the Job Training
OLTC	On Load Tap Changer
OT	Open Ticket Circuit
PABX	Private Automatic Branch Exchange
PC	Passenger Coach
PC sleeper	Prestressed concrete sleeper
ROC	Rail Operating Cost
ROI	Return on Investment
ROE	Return on Equity
ROUC	Rail Operating Unit Cost
ROW	Right of Way
SDH	Synchronous Digital Hierarchy
SL	Steam Locomotive
SS	Suspended Solides
TQC	Total Quality Control
TTC	Travel Time Cost
TTUC	Travel Time Unit Cost
TTUC	Travel Time Unit Value
UIC	International Railway Union
UN	United Nations
UNDP	United Nations Development Programme
VOC	Vehicle Operating Cost
VOUC	Vehicle Operating Unit Cost

Chapter 1 Outline of the Syrian Arab Republic

1.1 The National Economy

(1) Changes in the Economy

The Syrian economy can be briefly explained by two periods. The first period was from 1977 to 1987. During this period the economy was dominantly socialist with the private sector participation active in parts of the handicrafts industry, food processing industries, and agriculture. In terms of the economy the country had close ties with the former Soviet Union, the Eastern block and the Arab countries.

The second period (starting from 1988 to the present) began as the Former Soviet Union, Syria's main trading partner weakened and soon after collapsed. With the eruption of the Gulf war, Syria took a stand along the alliance led by Saudi Arabia and the Western World to liberate Kuwait, bringing it into contact with the Western world. Thereafter peace negotiations with neighbouring Israel took centerstage and the threat of war diminished. Under these conditions the Western world, including Japan took an active role in international cooperation with Syria.

The most significant action taken during this second period was the strategy Syria adopted for strengthening of free market economy in the country. Investment Law no. 10 was adopted in 1991. Within one year of promulgating this law the shares of the private sector in imports, exports (excluding crude oil), and fixed capital investments overtook those of the public sector. The law had a significant impact on the transport sector as explained by the large change in custom duties applied to the vehicles; before law no. 10 import duties on truck large size passenger cars and buses were 250% and 100% of their costs respectively, while Law no. 10 gave preferential duties for the same imports (0% in most cases).

(2) Economic Indicators

Since the 1960's the Syrian economy has diversified. The shares of the primary, secondary and tertiary industries are 30%, 20% and 50% respectively. Table 1.1.1 shows the economic indicators with respect to GDP during the period of 1977 to 1998.

Table 1.1.1 Economic Indicators w.r.t. GDP

(% of the GDP)	1977	1987	1997	1998
A – Economic activity				
Agriculture	18.5	25.4	27.8	29.2
Industry	24.4	19.4	17.9	17.3
Manufacturing	--	--	6.2	6.0
Services	57.0	55.2	54.3	53.5
B – Consumption shares				
Private consumption	67.4	77.1	58.2	59.3
General government consumption	19.6	18.0	16.7	16.6
C – Import of goods and services	40.7	28.9	31.4	29.0

Source: World Bank, 1998

(3) Trade

In 1997 the total exports exceeded the imports but than fell one year later. This is mainly due to the gradual increase in export of petroleum and petroleum products reaching a peak in 1997 and than falling more than half in the following year. Trade figures are shown in Table 1.1.2.

Table 1.1.2 Trade Indicators

(USD million)	1977	1987	1997	1998
Total Exports (fob)	1,070	1,340	4,057	3,089
Petroleum and petroleum products	621	703	2,509	1,628
Agricultural products	--	--	989	766
Manufactures	--	--	442	396
Total Imports (cif)	2,402	2,470	3,603	3,257
Food	--	--	674	492
Fuel and energy	422	492	115	81
Capital goods	--	--	821	824
Export price index (1995 = 100)	8	22	76	N.A
Import price index (1995 = 100)	5	22	68	N.A

Source: World Bank, 1998

1.2 Land Administration and Use

(1) Administrative Division

Syria is administratively divided into 14 governorates. Smaller administrative units exist within the governorates. These include cities, villages, towns, hamlets, counties, “Nahia” and “Mantika”.

(2) Regional Economic Conditions

The minerals and agricultural resources are shown in Figure 1.2.1. Syria’s economy has diversified since the 1960’s. Although agriculture is still the leading sector of the economy

and the main source of employment, its share of the gross domestic product has declined as industrial sector has grown. Less than one third of the country is cultivated because of aridity and poor soils. With the exception of the cultivated lands along the Euphrates River, approximately 80% of the agricultural land is still dependent on rain-fed sources. Rainfall variability causes fluctuations in grain production, which affects the industry. These cultivated areas located along the Mediterranean coast and the Eupthrates River have obviously developed rapidly within the country's land use structure and are served by the railway network. This developed land use structure has formed the basis for determining the development potential of Syria within this Study.

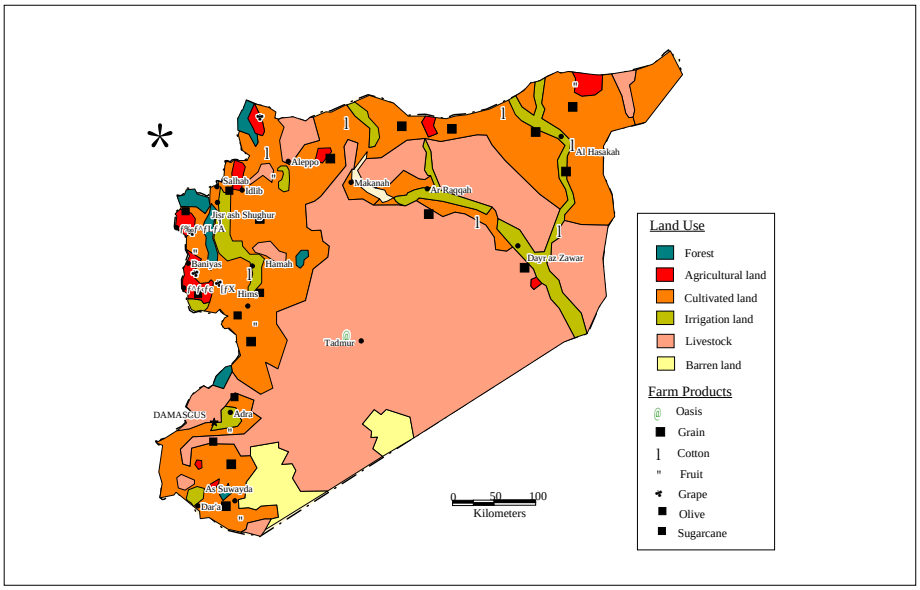


Figure 1.2.1 Land Use

Syria's industries are agrarian based – food processing and textiles. The main cash crop is cotton. In the mid 1960's the government began a policy of rapid industrialization, especially in the areas of iron and steel and other heavy industries. Syria has also exerted efforts in the exploration of oil resources. 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. The locations of the economic activities are shown in Figure 1.2.2.

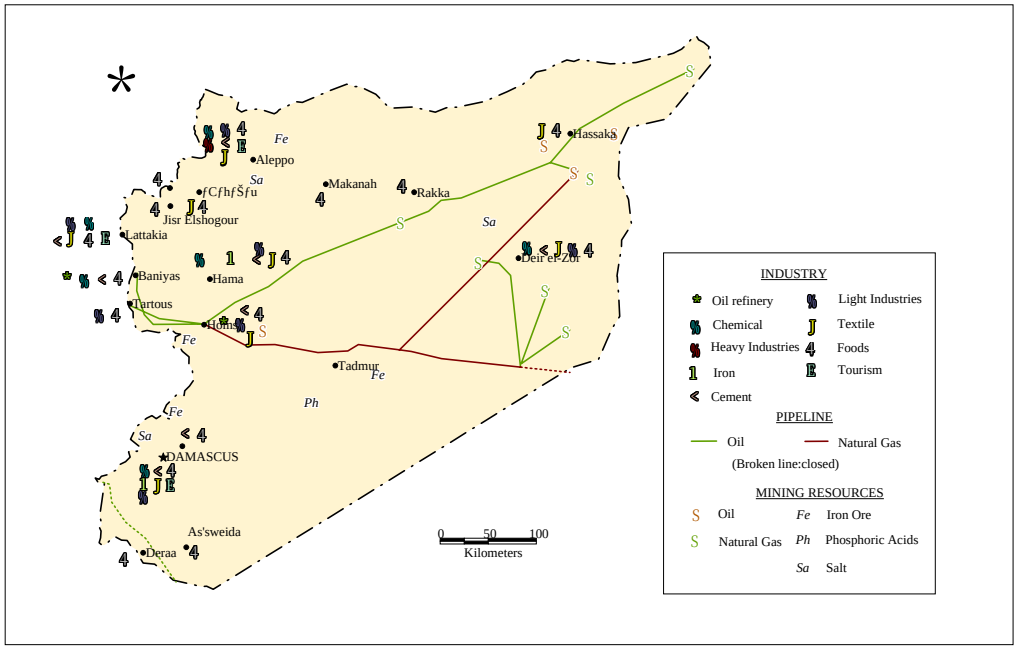


Figure 1.2.2 Industrial Map

Population distribution is shown in Table 1.2.1.

Table 1.2.1 Population Indicators

Governorate	Population	Population share of Total (%)	Growth rate 1970-1981	Growth rate 1981-1994	Pop/ built-up Area (p/ha)	Pop/ cultivated area (p/ha)	Pop/ Tot. area (p/ha)
Damascus City	1,404,000	8.3	2.63	1.80	33.1	14.1	1.5
Damascus Country	1,311,000	7.7	3.62	4.59	(included in Damascus City)		
Aleppo	3,922,000	23.1	3.30	3.61	56.8	3.2	2.1
Homs	1,546,000	9.1	3.72	3.16	17.4	3.9	0.4
Hama	1,494,000	8.8	3.32	3.11	28.7	3.1	1.5
Lattakia	975,000	5.7	3.27	2.36	60.9	8.8	4.2
Deir Az Zour	1,056,000	6.2	3.10	4.36	40.6	4.5	0.3
Idlib	1,353,000	8.0	3.84	3.48	33.0	4.0	2.2
Al Hasakeh	1,079,000	6.3	3.32	3.31	24.5	0.8	0.5
Al Rakka	635,000	3.7	3.31	3.59	11.8	0.7	0.3
As Sweida	392,000	2.3	3.29	2.30	13.5	2.1	0.7
Dar'a	734,000	4.3	4.15	4.03	9.8	3.2	2.0
Tartous	758,000	4.5	3.56	2.19	33.0	6.4	4.0
Quneitra	349,000	2.1	4.34	4.88	49.9	2.3	1.9
Total	17,008,000		3.35	3.30	27.8	2.8	

Source：Central Bureau of Statistics 1999, Syria

1.3 Gross Regional Domestic Product

(1) GDP/Capita of Labor

Based on the GDP and number of workers by activity type from the labour survey of 1998, the GDP/Capita of Labor was calculated, as shown in Table 1.3.1.

Table 1.3.1 GDP and Labourers by Economic Activity

Economic Activity	GDP (Mil. SP)	Labourers (persons)	GDP/labourer (Mil. SP/person)
Agriculture	219,170	875,609	0.250
Mining	114,212	512,551	0.223
Construction	28,383	516,111	0.055
Wholesale and retail trade	136,411	537,467	0.254
Transportation	81,289	213,563	0.381
Finance and insurance	28,379	53,391	0.532
Social Services	14,048	523,230	0.027
Government Services	55,004	327,463	0.168

Source: Labour survey, 1998

(2) Labour Force by Industry and Governorate

Table 1.3.2 shows the labour force by industry type and by governorate.

Table 1.3.2 Labour Force by Industry and Governorate

	Agricul-ture	Mining & manu-factur-ing	Construction	Whole-sale & retail trade	Transport & com-munica-tion	Finance & insur-ance	Social & personal services	Govern-ment ser-vices	Total
Damascus city	3,061	72,581	73,108	96,095	29,290	14,563	77,086	48,245	414,030
Damascus rural	45,609	92,580	93,300	73,349	33,767	7,995	102,249	63,993	512,842
Aleppo	163,459	95,338	96,259	199,346	45,310	12,043	97,456	60,993	770,205
Homs	45,303	45,859	46,128	26,835	19,156	4,226	35,947	22,497	245,952
Hama	129,329	39,135	39,339	31,435	12,225	2,126	21,968	13,748	289,306
Lattakia	27,090	26,895	27,155	30,413	15,065	3,272	35,947	22,497	188,334
Deir el-Zor	97,953	17,413	17,581	8,945	5,794	827	21,968	13,748	184,229
Idlib	109,126	30,860	31,158	26,835	11,327	1,349	25,962	16,248	252,866
Hassaka	100,555	29,481	29,766	11,245	10,055	1,680	35,148	21,998	239,928
Raqqa	54,180	20,171	20,192	4,345	5,692	929	13,181	8,249	126,939
Sweida	17,601	8,793	8,703	4,089	3,283	1,044	8,388	5,249	57,150
Daraa	28,468	11,896	11,837	6,900	8,646	1,069	24,364	15,248	108,428
Tartous	50,660	19,826	20,018	16,868	13,157	2,151	23,166	14,498	160,344
Quneitra	3,214	1,724	1,567	767	795	115	399	250	8,831
Total	875,609	512,551	516,111	537,467	213,563	53,391	523,229	327,463	3,559,384

Source: Statistical Abstract 1989-1999

(3) Estimation of GRDP

GRDP was estimated by multiplying the GDP per worker in each economic activity type with the number of workers in each governorate belonging to that economic activity. The result is shown in Table 1.3.3.

Table 1.3.3 GRDP Estimation (1998)

(Unit: Million SP)

	Agricul-ture	Mining & manufact uring	Constru ction	Wholesale & retail trade	Transport & commu-nication	Finance & insur-ance	Social & personal services	Govern-ment ser-vices	Total
Damascus city	12,182	36,803	9,152	43,005	24,002	11,990	4,815	18,853	160,801
Aleppo	40,915	21,244	5,294	50,595	17,246	6,401	2,617	10,245	154,557
Homs	11,340	10,219	2,537	6,811	7,291	2,247	965	3,779	45,188
Hama	32,372	8,721	2,163	7,978	4,653	1,130	590	2,309	59,916
Lattakia	6,781	5,993	1,493	7,719	5,734	1,739	965	3,779	34,203
Deir el-Zor	24,518	3,880	967	2,270	2,206	440	590	2,309	37,180
Idlib	27,315	6,877	1,714	6,811	4,312	717	697	2,729	51,171
Hassaka	25,169	6,569	1,637	2,854	3,827	893	944	3,695	45,589
Raqqa	13,562	4,495	1,110	1,103	2,167	494	354	1,386	24,670
Sweida	4,406	1,959	479	1,038	1,250	555	225	882	10,793
Daraa	7,126	2,651	651	1,751	3,291	568	654	2,561	19,253
Tartous	12,681	4,418	1,101	4,281	5,008	1,144	622	2,435	31,689
Quneitra	805	384	86	195	303	61	11	42	1,886
Total	219,170	114,212	28,383	136,411	81,289	28,379	14,048	55,004	676,896

Chapter 2 Transport Conditions

2.1 Overall Transport Network

Syria's transportation infrastructure includes road, railway, air and pipeline networks. These are shown in Figure 2.1.1.

Figure 2.1.1 Basic National Transportation Infrastructure Networks

In terms of the domestic transportation the road network is the most widely spread and therefore utilized transport mode (refer to Table 2.1.1).

Table 2.1.1 Transport Volume by Mode (1999, inter-governorate traffic only)

Transport mode	Passenger (pax・km)	Freight (ton・km)
Road transport (estimated)	34,136,101	51,509,883
Railway	573,351	4,477,920
Air	Very small amount	Very small amount
Marine	No domestic marine transport	No domestic marine transport
Pipeline	—	Exclusively for crude oil and natural gas

Figure 2.1.2 shows the 1999 traffic modal shares in Syria for both freight and passenger. Road and rail modes shares are nearly 100% and the share of air transport mode is very low for both freight and passenger.

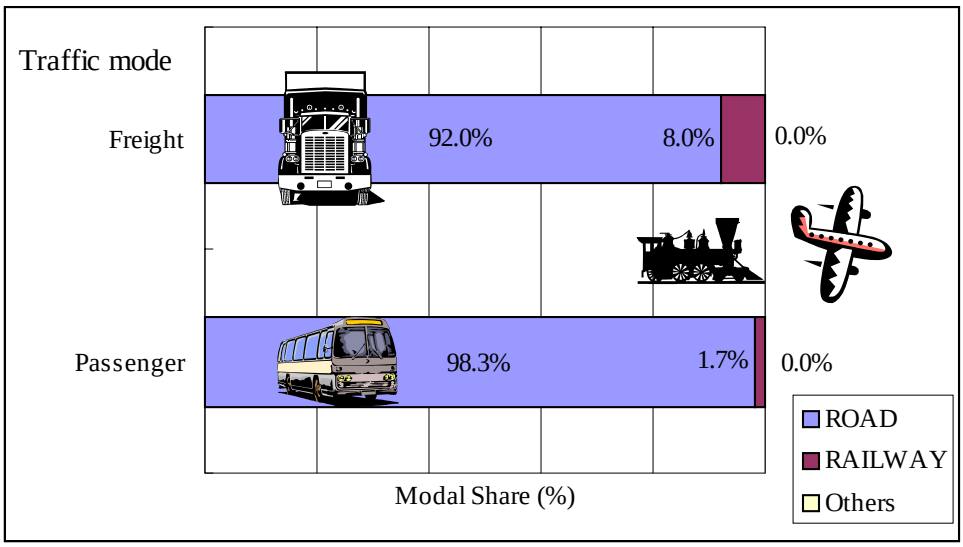


Figure 2.1.2 Traffic Modal Share in Syria

2.2 Road Network in Syrian Arab Republic

(1) Traffic Volumes

Traffic volumes for the three years of 1995 to 1997 are shown in Table 2.2.1.

Table 2.2.1 Traffic Volumes (average daily vehicles, both directions)

Road name	1995	1996	1997	Average growth (%)
1. Homs – Damascus	18,648	19,130	19,819	3.06
2. Homs – Tartous – Lattakia	13,071	14,451	17,107	13.96
3. Homs – Hama – Aleppo	14,719	14,947	15,085	1.22
4. Damascus – Jordanian border	6,434	8,763	9,657	18.39
5. Damascus – Lebanese border	7,845	11,563	12,397	19.68
6. Aleppo – Manbej – Al-Yaroubiye	3,664	5,574	6,200	22.75
7. Damascus – Tadmor – Hassaka	3,835	4,500	5,005	13.00
8. Lattakia – Jisr Elshogour – Ariha	5,279	5,970	6,532	10.49

Source: World Bank Sector Report, February 1999

Figures 2.2.1 and 2.2.2 show the daily traffic volume for passenger vehicles and freight vehicles respectively based on the surveys implemented in 2000 by the Study team and the survey data collected from the Ministry of Communications.

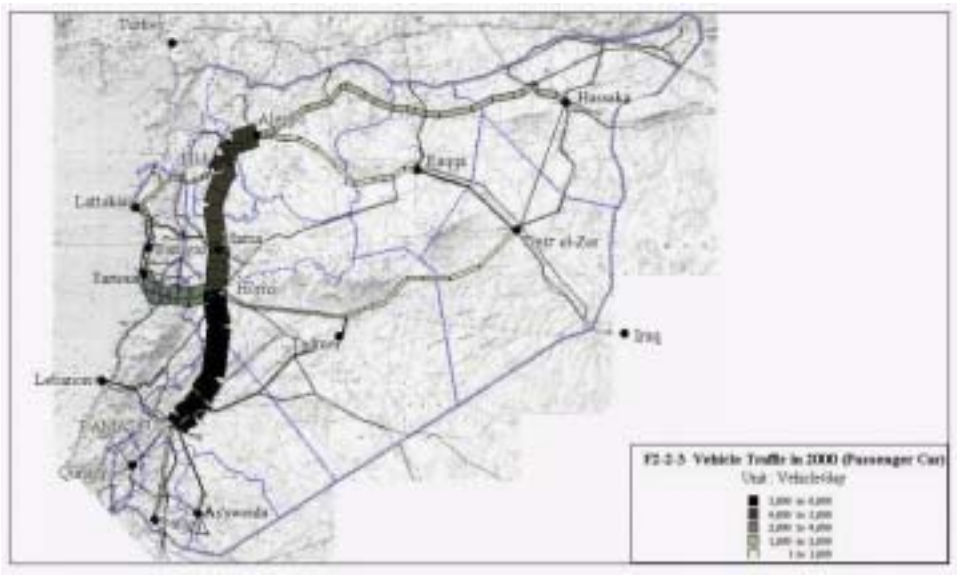


Figure 2.2.1 Road Traffic Volume (Daily, Passenger vehicle)

There are 5,000 passenger vehicles daily along the Homs – Damascus link that is the largest traffic volume link. The Homs – Aleppo link and Homs – Tartous – Lattakia link also have heavy passenger traffic of 2,000 to 5,000 daily.

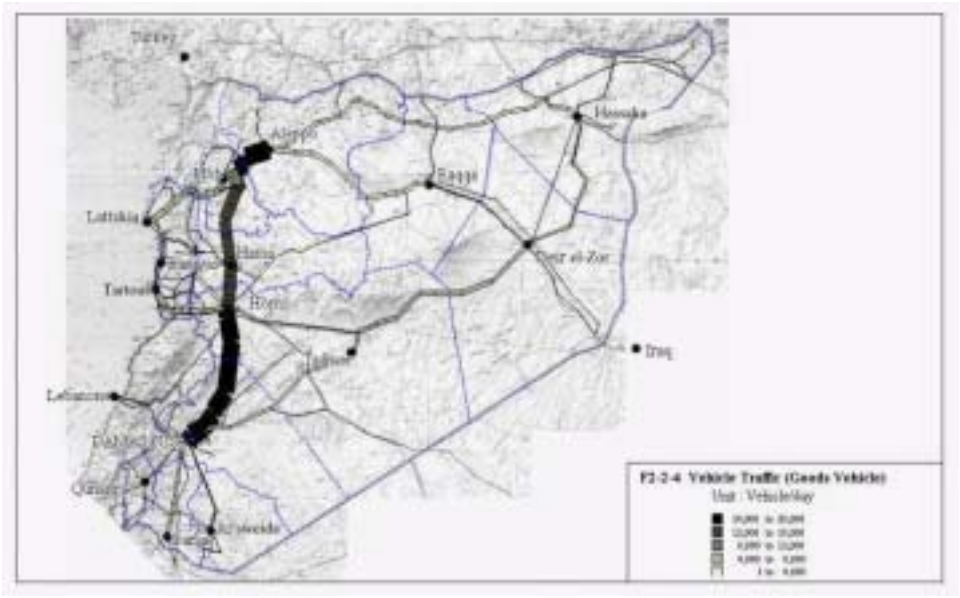


Figure 2.2.2 Road Traffic Volume (Daily, Freight vehicles)

Numbers of vehicles transporting goods are on average 4 times the number of those transporting passengers on most of the links. The largest number of freight trucks was observed along Aleppo – Homs – Damascus at 16,000 to 20,000 vehicles.

(2) New Road Projects

The ministry is considering a number of road projects as follows:

1) Aleppo – Raqqa Road widening to four lanes through construction of a new road parallel to the existing one.
2) Damascus Outer Ring Road
3) Hassya – Al Qusair – Talkalakh new road to bypass Homs city for the Damascus – Tartous – Lattakia traffic.
4) Raqqa – Deir el Zor – Al Bukamal new road construction
5) Five new maintenance centers

2.3 Railway Network

The Syrian railway network is shown in Figure 2.3.1.

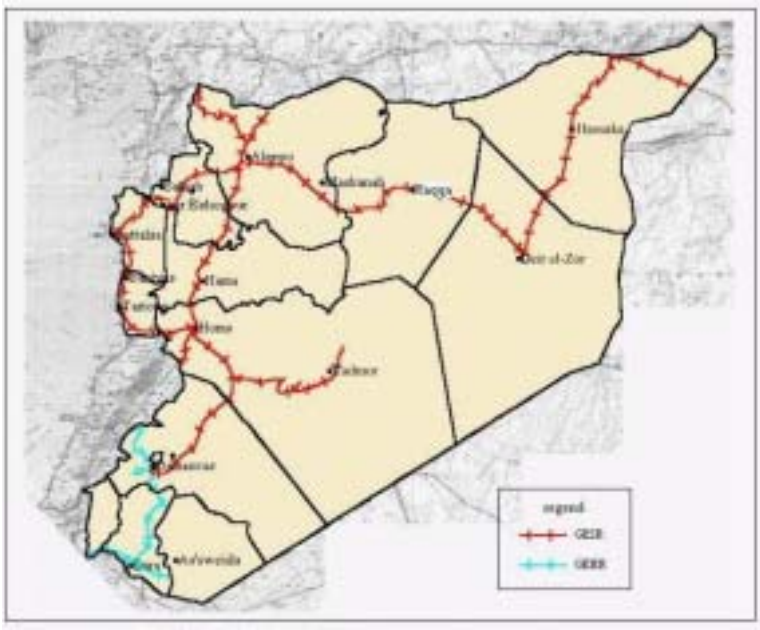


Figure 2.3.1 Railway Network

2.3.1 General Establishment of Syrian Railways (GESR)

The main lines are as shown in the figure and described below;

(1) The north-south route crossing the Syrian-Turkish border and traveling through Aleppo, Hama and Homs to reach Damascus. This route passes through the heavily populated areas of Syria.

(2) The west-east route starting from Lattakia, passing through Aleppo, continuing along

Euphrates River to Deir el Zor, then to Qamishli and crossing into Turkey. This route serves Syria's cultivable areas transporting many agricultural products.

(3) The Coastal route connects to the north-south route traveling from Lattakia, through Tartous at Homs. Lattakia and Tartous are the first and second seaports in Syria respectively and in terms of foreign trade together account for 65% of total imports entering the country and 15% of the total exports (both in weight base). This line has a large potential in connecting the high population density areas of Damascus and Aleppo with the important seaports serving foreign trade.

(4) The route from Homs to Al-Sharqia. This line transports the phosphate ore extracted from the Al-Sharqia area to Tartous.

GESR classifies 47 stations as main stations or the stations where branch lines start. GESR has over 100 branch lines. These lines mostly connect with grain silos, phosphate mines and petroleum products production facilities.

The operation indicators for 1999 are given in Table 2.3.1.

Table 2.3.1 Operation indicators in 1999

Unit	Plan	Actual	Actual (%)
A. Transported Passengers and Freight			
Passenger number (1,000 persons)	676.6	755.7	111%
Freight (1,000 tons)	4,167.5	4,605.1	110%
B. Investment Plan			
Investment amount	SP 1,875 M	SP 1,125 M	60%

In 1995 two studies were made by GESR for construction of two new lines; the first linking Deir el-Zor with Al-Bukamal on the Iraqi border and the second linking Damascus to the Jordanian border through Daraa and parallel to the existing Hidjaz line. Table 2.3.2 summarizes the two projects briefly as noted in the study reports.

Table 2.3.2 Two New Projects proposed by GESR

Item	Deir el-Zor – Al-Bukamal	Damascus – Daraa
1. Total length including branch lines (km)	189.5	201
2. Number of Stations	8	7
3. Construction cost estimate (1995)	SP 6,764 M	SP 7,353 M
4. Present project status	45 km of earthwork already completed. Work proceeds, as funds are made available.	Russian design prepared in 1987. 30% of required earthwork completed. Presently no funds to proceed.

2.3.2 General Establishment for Hidjaz Railways (GEHR)

Hidjaz railway has in the past played an important religious role in transporting the Moslem pilgrims to the holy cities in Saudi Arabia for the annual “Haj” pilgrimage. The Hidjaz railway links the three Arab countries of Syria, Jordan and Saudi Arabia. At present there are only 340 kilometers of GEHR tracks and the operation frequencies are extremely low. Furthermore the section located in Saudi Arabia is not operated. The section in Jordan is operated at low frequency in the same manner as that in Syria.

The GEHR network can be classified into five lines as shown in Figure 2.3.2. There are 38 stations serving this network and the average distance between the stations is 12 kilometers on 4 of the 5 lines. In the case of Damascus – Qattana the stations are more closely spaced (at average 5-kilometer distances).

The operation indicators for the GEHR are reproduced in Table 2.3.3.

Table 2.3.3 Operation Indicators for GEHR

Year	Passenger	Freight (ton)	Tourist/ private trips	Rail revenue (SP)	Share of Tot. revenue (%)	Expenditure
1994	13,641	2,291	0	3,601,470	5%	35,644,682
1995	62,930	600	6	10,856,484	15%	45,428,411
1996	78,922	1,691	33	5,432,702	4%	63,634,843
1997	85,333	2,350	33	7,741,898	4%	83,129,171

Figure 2.3.2 GEHR Network (Syria, Jordan and Saudi Arabia)

2.4 International Railway Network

Syria and its neighboring Middle East countries have been engaged in constructive discussions, within the framework of DGMO organization, to link their railway systems and introduce smoother rail transport amongst these countries. DGMO refers to the General Directors of Railways in Middle Eastern countries.

The members of DGMO include Syria, Iran, Turkey, Egypt, Iraq, Lebanon, Jordan and Saudi Arabia. Other Arab Gulf states, Central Asian countries, Pakistan, Afghanistan and India are not members of DGMO, but in future their railway network will be integrated with DGMO railway network after the latter's railway network itself will be adequately developed.
UIC generally attends the meeting as an able adviser and provides useful suggestions to DGMO based on its rich experiences in integration of European railways.

The latest DGMO meeting was held in Aleppo in July 2000. The Study Team was invited to attend the meetings and this section is prepared on the basis of discussions held at that time.

GESR emphasized the importance of developing its railway system in order to serve international rail transport during the meeting. GESR outlined its development strategy in that connection along 5 main axes.

(1) Istanbul (Turkey) – Midan Ekbes/Aleppo – Damascus/Daraa (Syria) – Amman – Aqaba (Jordan)
(2) Tehran – El Razi (Iran) – Malatia – Istanbul (Turkey)
(3) Tehran – Arak – Khasafy (Iran) – Baghdad (Iraq) – Al-Bukamal – Deir el-Zor – Aleppo – Midan Ekbas (Syria) – Istanbul (Turkey), or Aleppo－Damascus
(4) a) Tehran – Kharem Shaher (Iran) – Basra – Baghdad (Iraq)
b) Tehran – Khasafy – Mosul – Syria
(5) Adana – Nassibbein (Turkey) – Al-Yaroubiye (Syria) – Mosul (Iraq)

It is important to note that DGMO countries are recognizing significant role which the development of international railway network plays in promoting intra-and inter-regional socio-economic development.
In order to promote intra-and inter-regional railway network development, much efforts are also put on bilateral cooperation besides multilateral discussion in DGMO meeting.

Chapter 3 Current Situation and Issues of GESR

3.1 Transport

3.1.1 Outline of train operating line

(1) Train operating line

	Line Name	Section	Distance (km)	Remarks
1	Jubrin- Midan Ekbas	Jubrin – Midan Ekbas	133.2	
2	Jubrin- Damasucus	Jubrin – Damascus	401.9	
3	Muslimiyya-Arrai	Muslimiyya-Arrai	85.9	Out of service
4	Jubrin –Lattakia- Homs 1	Jubrin –Lattakia Lattakia- Lattakia Port Lattakia- Tartous Tartous- Tartous Port Tartous- Homs 1	204.9 5.9 85.9 4.0 95.3	
5	Jubrin- Qamishli- Al Yaroubiye	Jubrin- Deir el-Zor (passenger) Deir el-Zor- Old Qamishli New Qamishli-Al Yaroubiye	323.0 198.6 79.5	
6	Mhine- Al Sharqia	Mhine- Al Sharqia	110.7	

(2) Train maximum speed and speed limit at turnout

1) Maximum speed

Passenger Train 100 km/h

Freight Train (general) 80～60 km/h

2) Speed limit at turnout

The speed limit is 70 km/h imposed for main line straight side while 40 km/h for curved side, however, the speed limit of 40 km/h is imposed on all the points regardless of straight side or curved side due to defective track maintenance.

In addition, the speed limit is 30 km/h on the point that have been fixed on the sleepers with dog spikes at closed stations so that engine driver can confirm safe running.

3) Among a total of 102 stations, 22 stations are closed due to no needs.

(3) Types of trains and train formation

1) Passenger Train (Express)

	Train No.	Section				Schedule Time	Distance	Schedule Speed	Remarks
		Departure		Arrival					
		Station	Time	Station	Time				
1	30	Aleppo	0:30	Damascus	6:25	5:55	395.6	66.8	7 car
	35	Damascus	16:05	Aleppo	21:35	5:30	395.6	71.9	
2	255	Aleppo	23:30	Qamishli	6:59	7:29	546.9	73.1	6 car
	256	Qamishli	22:45	Aleppo	6:30	7:45	546.9	70.5	
3	44	Aleppo	5:48	Lattakia	8:29	2:41	198.6	74.0	In Summer 6 car
	49	Lattakia	21:00	Aleppo	23:48	2:48	198.6	70.9	
4	242	Aleppo	7:00	Lattakia	9:59	2:59	198.6	66.7	6 car
	243	Lattakia	6:45	Aleppo	9:51	3:06	198.6	64.1	
5	246	Aleppo	15:35	Lattakia	18:40	3:05	198.6	64.4	6 car
	245	Lattakia	15:30	Aleppo	18:30	3:00	198.6	66.2	
6	23	Damascus	15:00	Lattakia	20:40	5:40	380.8	67.2	The day before holiday 4car
	22	Lattakia	23:30	Damascus	5:12	5:42	380.8	66.8	Holiday 4car
7	65	Damascus	5:13	Midan Ekbas (Istanbul)	13:40	8:27	512.2	60.6	Tuesday 2 car
	66	(Istanbul) Midan Ekbas	11:40	Damascus	20:06	8:26	512.2	60.7	Monday 2 car
8	663	Aleppo	14:45	Midan Ekbas	17:56	3:11	116.6	36.6	2 car
	660	Midan Ekbas	6:40	Aleppo	9:28	2:48	116.6	41.6	2 car
9	53	Aleppo	22:00	Al Yaroubiya (Mosru)	6:36	8:36	630.0	73.7	2000/8/12～ Saturday 4 car
	52	Al Yaroubiya (Mosru)	23:45	Aleppo	8:28	8:43	630.0	72.3	2000/8/12～ Friday 4 car

2) Freight Train

GESR mainly handles freight traffic; in terms of train kilometer it is more than four times greater than those of passenger trains, and in terms of train frequency 13 times greater.

Based on the information collected until 8:00 a.m. in the previous morning, only required number of freight trains are to be selected for operations from diagrams fully set up to the line capacity beforehand. Roughly 2 to 5 round-trip trains are operated on each line.

(a) Formation and Hauling Weight

① Exclusive freight trains for phosphate transport 16 wagons 1400 ton

② Other trains 2000ton～1400ton～300ton

Tractive force coefficient is about 60%, averaging ① and ② above.

(4) Frequency of passenger trains and freight trains for each line section

Table 3.1.1 Number of train for each line section (Peak day)

↓						Station Name	↑						↑ ↓
Total	Freight	Mixed	Passenger				Passenger			Mixed	Freight	Total	Grand Total
			Express	Other	Total	Midan Ekbas	Total	Other	Express				
7	5	1	1		1	Muslimia	1		1	1	5	7	14
10	8	1	1		1	Aleppo	1		1	1	8	10	20
11	6		5		5	Aleppo	5		5		6	11	22
5	2		3		3	Wudehi	3		3		2	5	10
8	7		1		1	Lattakia	1		1		7	8	16
10	9		1		1	Tartous	1		1		9	10	20
10	9		1		1	Akkari	1		1		9	10	20
						Homs							
11	6		5		5	Aleppo	5		5		6	11	22
6	4		2		2	Wudehi	2		2		4	6	12
6	4		2		2	Hama	2		2		4	6	12
16	13		3		3	Homs	3		3		13	16	32
8	5		3		3	Mhine	3		3		5	8	16
						Damascus							
6	4		2		2	Aleppo	2		2		4	6	12
5	3		2		2	Raqqa	2		2		3	5	10
4	2		2		2	Deir el-Zor	2		2		2	4	8
4	2		2		2	Hassake	2		2		2	4	8
6	5		1		1	Nusaibin	1		1		5	6	12
						Al-Yaroubiye							
8	8		0		0	Mhine	0				8	8	16
						Al-Sharqia							

(5) Operating schedule of locomotive

There in no specific operating schedule table for locomotive. Locomotive operation is programmed as pair train operation in principle. When necessary, locomotive is operated in coordination with train dispatcher.

Average locomotive-km par day is 184km (80 locomotives are in use). Average locomotives running time per day is 12 hours.

3.1.2 Record of train operation

(1) Number of train, Train Km and Car km

Number of train, Train Km and Car km in 1995～1999 are shown in Table 3.1.2.

Table 3.1.2 Number of train, Train Km and Car km

1day average

Year	Number of train		Train operating Km		Car km		
	Passenger train	Freight train	Passenger train km	Freight train km	Passenger car km	Freight car km	Locomotive km
1995	20.5	101.3	6,459.0	10,421.0	37,481.1	158,701.3	17,415.3
1996	20.5	101.6	6,456.1	10,631.9	37,967.0	152,824.7	17,585.2
1997	13.7	116.9	4,705.6	11,545.9	28,628.3	181,838.1	17,096.5
1998	8.6	111.7	2,912.4	11,359.0	17,962.2	171,229.0	13,324.4
1999	8.6	112.6	2,931.5	11,453.4	18,141.9	174,268.6	14,767.1

(2) Transport fluctuation

1) Passenger

As for passenger traffic fluctuation, traffic is high in summer and reaches to 180% of annual average during July through September, however falls down to 60%in winter during December through February.

As for passenger traffic fluctuation, traffic is high in summer and reaches to 114% of annual average August through September.

2) Freight

Actual record of freight transport volume by month are shown in Table 3.1.3.

Table 3.1.3 Transport volume fluctuation

1999

Month	Freight Transport Ton	Fluctuation Ratio %
1	408,992	90.1
2	410,813	90.5
3	479,674	105.7
4	446,027	98.3
5	448,087	98.8
6	418,124	92.2
7	457,384	100.8
8	508,520	112.1
9	516,348	113.8
10	511,084	112.6
11	380,270	83.8
12	459,422	101.3
Total	5,444,745	
Avarage	453,729	100

(3) Load factor

1) Passenger train

The annual average is 49.1% in 1999; high in summer while low in winter.

In terms of type of train, the average of night trains between Aleppo and Damascus is 80% throughout the year, but it is contrarily about 30% for daytime trains.

Between Aleppo and Qamishli, only a night train is operated and the loading factor is around 30%, and that of night trains between Damascus and Lattakia is somewhat 20%, the loading factor of daytime operations even in summer is about 10% and that is less than 10% in winter.

The loading factor of trains running between Aleppo and Lattakia is high on average. In particular, trains are crowded in summer.

2) Freight rain

Some train having hauling capacity of 2000～1400～300 ton haul train with load factor of 100, however, on average, load factor is about 60%

(4) Train delays and cancellations

1) Train delays

Both passenger trains and freight trains are always delayed. Most of the delays are caused by poor maintenance of locomotives, degraded track condition and signal breakdown.

Average delayed hour per train during March 21 through March 30 1999: 3.3 hours

2) Train Cancellation

Main causes of train cancellations are due to no payload and lack of locomotive

(5) Accidents

Number of Accidents in 1996～1999 is classified as shown Table 3.1.4

Table 3.1.4 Number of accidents (1996～1999)

	1996	1997	1998	1999	Remarks
Derailment	70	64	46	54	
Breaking of Turnout&signal	50	38	34	34	
Collision with other rolling stock within stationyard	8	10	11	6	
Other(Broken Track, Fire, Escape)	15	24	19	22	
Collision of Vehicles	52	39	30	31	at level crossing
Hitting Person	29	26	21	20	
Hitting Animal	4	5	3	5	
Total(A)	228	206	164	172	
Number of Train(B)	44,558	47,651	43,890	44,229	
Train km(C)	6,237,136	5,931,798	5,209,068	5,250,476	
Accident Rate(D=A/B×1000)	5.1	4.3	3.7	3.9	
Accident Rate(E=A/C*1,000,000)	36.6	34.7	31.5	32.8	

3.1.4 Train Dispatching Systems

Dispatchers' offices are located at Aleppo and Homs with 2 dispatchers each on 3-shift system for 24 hours covering all sections except Old Qamishili～Al Yaroubiye and Sharbit～Al Roueisa. Train dispatcher records actual diagrams through reported telephone by each station, and control, trains with telephone communications. Although locomotives are equipped with radios, communication with dispatchers is not possible, but is possible with station master.

3.1.5 Line capacity

There is an allowance for line capacity at present.

3.1.6 Train Crew

(1) Crew members aboard a train consist of the following:

Passenger train
- Driver (1)
- Assistant Driver (1)
- Train Master (1)
- Conductor and other (6)

Total: 9

Freight train
- Driver (1)
- Assistant Driver (1)
- Train Master (1)

Total 3

(2) Number of driver and assistant driver

Total number of driver and assistant driver are as follow.

Driver	347
Assistant driver	237

3.2 Rolling stock and workshop

3.2.1 Current situation of rolling stock

(1) Locomotive

Current number of Locomotive (2000. June)

Type	Number of the book	Number available for use	Number under repair etc.	Rate available for use
LDE2800 (old)	29	0	29	0
LDE2800 (new)	77	22	55	29
LDE1800	26	20	6	77
LDE1500	25	20	5	80
LDE1200	11	9	2	92
Total	168	71	97	42

(2) Passenger coach

Current number of Passenger coach (2000. June)

Type	Number of the book	Number available for use	Number under repair etc.	Rate available for use
1 st	115	100	15	87
2 nd	258	242	16	94
Sleeping	44	42	2	95
Restaurant	19	19	0	100
Special salon	3	3	0	100
1 st + Sleeping	10	5	5	50
Luggage + Mail	30	25	5	83
Total	479	436	43	91

(3) Freight wagon

Current number of Freight wagon (2000. June)

Type	Number of the book	Number available for use	Number under repair etc.	Rate available for use
Tank	951	851	100	89
Cereal	597	583	14	98
Phosphate	323	312	11	97
Cement	90	77	13	86
Covered	940	880	60	94
Flat	2,159	2,104	55	97
Total	5,060	4,807	253	95

3.2.2 Current situation of workshop

(1) Locomotive workshop

About 390 staff are carrying out periodical maintenance of M4～M6 and temporary large scale maintenance of major parts for locomotives.

In locomotive workshop, it takes about 2.5 months for periodical maintenance/repair for M6 of LDE2800, about 2.5 months for M8 of LDE1800 and about 2 months for M6 of LDE1500.

(2) Passenger coach workshop

About 180 staff are carrying out periodical maintenance of T1～T6 and temporary large scale maintenance of major parts for passenger coaches.

In passenger coach workshop, it takes about 1.5 months for periodical maintenance/repair of T6.

(3) Freight wagon workshop

About 150 staff are carrying out periodical (every 3～15 years) maintenance and temporary large scale maintenance such as repair of wagons damaged by collision etc.

In freight wagon workshop, it takes about max. 1 (one) week for overhaul.

3.2.3 Current situation of maintenance system of rolling stock and workshop

(1) Inspection cycle and place

1) Locomotive

Type	M1	M2	M3	M4	M5	M6	M7	M8	M9
LDE2800 (old)	After operate	5,000 km	25,000 km	100,000 km	200,000km	600,000 km	-	-	-
	Depot	Depot	Depot	Workshop	Workshop	Workshop			
LDE2800 (new)	After operate	5,000 km	25,000 km	200,000 km	400,000 km	900,000 km	-	-	-
	Depot	Depot	Depot	Workshop	Workshop	Workshop			
LDE1800	After operate	8,000 km	25,000 km	50,000 km	200,000 km	400,000 km	800,000 km	1,200,000 km	1,600,000 km
	Depot	Depot	Depot	Depot	Workshop	Workshop	Workshop	Workshop	Workshop
LDE1500	After operate	15 days	3 months	1 year or 75,000～100,000 km	2 years or 150,000～200,000 km	6 years or 500,000 km	-	-	-
	Depot	Depot	Depot	Depot	Depot	Workshop			
LDE1200	After operate	15 days	3 months	1 year or 100,000 km	2 years or 200,000 km	6 years or 600,000 km	-	-	-
	Depot	Depot	Depot	Workshop	Workshop	Workshop			
LDE650	After operate	15 days	3 months	6 months	-	-	-	-	-
	Depot	Depot	Depot	Depot					

2) Passenger coach

Type	Inspection	Inspection	T1	T2	T3	T4	T5	T6
East germany	After operate	9 months or 70,000 ～ 100,000 km	2 years or 400,000 km	4 years or 800,000 km	6 years or 1,200,000 km	8 years or 1,600,000 km	10 years or 2,000,000 km	12 years or 2,400,000 km
	Depot	Depot	Workshop	Workshop	Workshop	Workshop	Workshop	Workshop
Poland Rumania	After operate	9 months or 70,000 ～ 100,000 km	3 years or 300,000 km	6 years or 600,000 km	9 years or 900,000 km	-	-	12 years or 1,200,000 km
	Depot	Depot	Workshop	Workshop	Workshop			Workshop

3) Freight wagon

Type of inspection	Inspection cycle	Place of inspection
-	After every operation	Depot
Semi-overhaul	3 years, 4 years, 5 years	Workshop
Overhaul	6 years, 8 years, 9 years, 12 years, 15 years	Workshop

3.2.4 Current major issues and improvement

(1) Rolling stock

1) Common

Quality control of brake block must be improved urgently.

2) Locomotive

In order to decrease the number of locomotives waiting for repair due to the shortage of spare parts, it is necessary to procure spare parts of engine, traction motor etc. and raise the operation rate of locomotives.

3) Passenger coach

In order to decrease the number of passenger coaches waiting for repair due to the shortage of spare parts, it is necessary to procure spare parts of battery, air-brake etc.

It is necessary to take measure to meet hand brake is not forgotten to be opened.

4) Freight wagon

80% of total number of wagons under repair are the ones damaged by collisions in shunting work etc., so the prevention of collision of wagons is extremely necessary.

It is necessary to take measure to meet hand brake is not forgotten to be opened.

(2) Workshop and depot

1) Locomotive workshop

It is necessary to construct the modern locomotive workshop including foundry shop for brake shoes.

2) Passenger coach workshop

It is necessary to construct the modern passenger coach workshop.

3) Freight wagon workshop

It is necessary to revise the layout of existing freight wagon workshop.

4) Locomotive depot

It is necessary that the adequate number of spare parts should be provided with.

In addition to the above, it is necessary to establish the effective maintenance system by transmitting contents of temporary maintenance in depots, to the related staff in workshop and others.

5) Passenger coach depot

It is necessary that the adequate number of spare parts should be provided with.

In addition to the above, it is necessary to establish the effective maintenance system by transmitting contents of temporary maintenance in depots, to the related staff in workshop and others.

6) Freight wagon depot

It is necessary that the adequate number of spare parts should be provided with.

In addition to the above, it is necessary to establish the effective maintenance system by transmitting contents of temporary maintenance in depots, to the related staff in workshop and others.

3.3 Permanent Way Facilities

3.3.1 Track Standards

Syrian Railways (GESR) are divided into two parts, namely a route in northern region of Syria constructed at the end of the Ottoman Empire and another route expanded by Russian railway engineering during the age between 1960s and 1970s. The railway has been unified as a third-grade track of Russian Standard (annual tonnage of 8 million tons to 15 million tons). Major characteristics are as follows:

Maximum Design Speed:	Passenger train – 120 km/h (Operating speed 100km/h)
	Freight train – 100 km/h (Operating speed 80km/h)
Track Gauge:	1,435 mm (Standard Gauge)
Minimum Radius of Curve:	R = 600 m (R = 300 m where required)
Maximum Cant:	150 mm
Maximum Slack:	20 mm
Maximum Gradient:	G = 12.0‰ (25‰ where required)
Design Load:	Russian Railway Standard Load (S12 load)(12ton/m)
	Axle load 25 tons (See Fig. 3.3.1)
Rail:	P50
Sleeper:	PC Sleeper L=2,420, 1,600-1,840/km, St. 1,440/km
Fastening:	K2, Kb, RN, Nabra
Ballast:	250mm (Ballast) + 100mm (Sand) (Under Sleeper)
Turnout:	Main Line 11# , Sub Line 9#
Construction Gauge:	As shown in Fig. 3.3.2
Railway Track Cross	
Sectional Dimensions:	As shown in Fig. 3.3.3

(Note: In the case of improvement, UIC standard for track shall be used.)

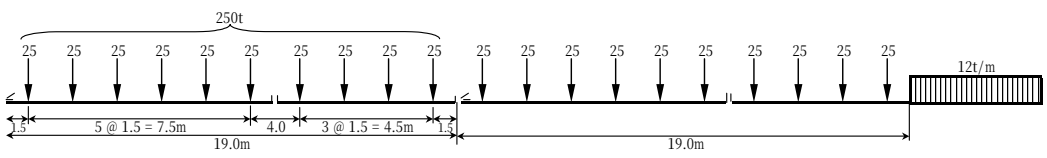
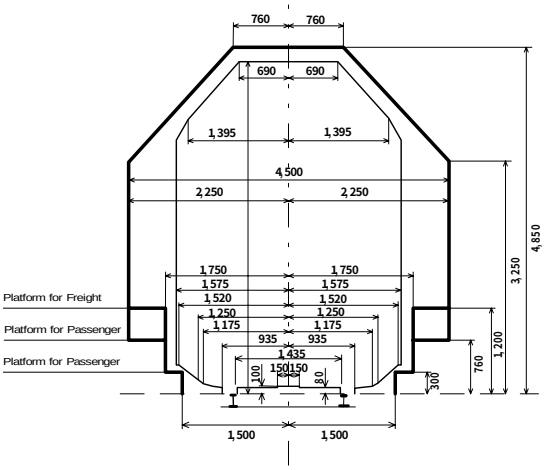


Fig.3.3.1 Standard Load



Unit : mm

Fig.3.3.2 Construction Gauge

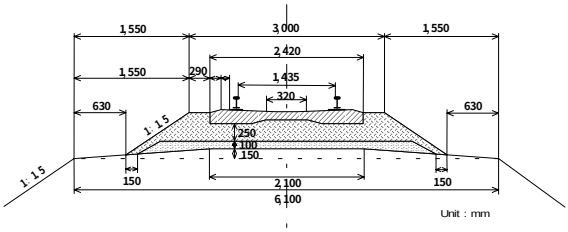


Fig.3.3.3 Railway Track Cross Section Dimension

3.3.2 Railway Alignment

The alignment is as shown in Fig. 3.3.4. The route crossing over mountain ridges consists of small radius of curves with steep gradients.

Fig.3.3.4(1) Topographical Map

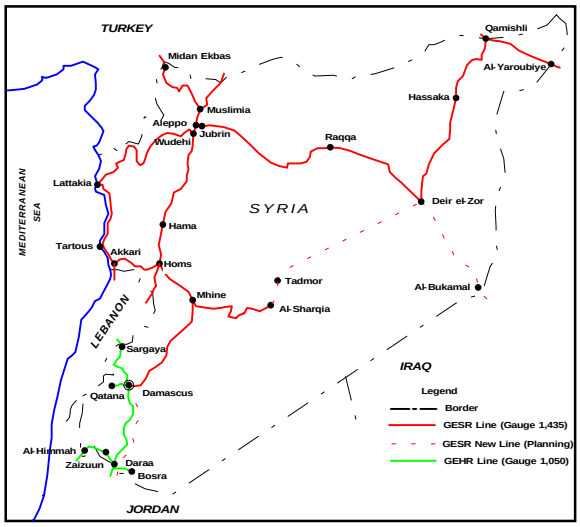


Fig.3.3.4(2) Syrian Railway Network

While, the alignment of the section crossing desert regions consists of large radius of curves with moderate gradients.

The summary of curves and gradients of respective lines is as shown in Table 3.3.1 and Table 3.3.2.

Table 3.3.1 Table of Curve

Curve	Jublin - Homs 2			Homs 1 - Damascus			Homs 1 - Tartous -Al-Kabil			Lattkia - Wdehi			Jublin - Old Qamishli		
	Length			Length			Length			Length			Length		
R (m)	(m)	(%)	No.	(m)	(%)	No.	(m)	(%)	No.	(m)	(%)	No.	(m)	(%)	No.
200≦R＜300							67	0.1	1						
300≦R＜400				1,123	2.5	3	16,092	21.5	43						
400≦R＜500	4,932	10.1	12	942	2.1	2	5,353	7.2	18	38,103	55.3	100	100	0.2	1
500≦R＜600	2,100	4.3	6	1,690	3.8	2	2,471	3.3	6	7,455	10.8	19	810	1.5	1
600≦R＜700	12,480	25.5	25	8,553	19.3	13	18,349	24.5	40	6,479	9.4	21	16,944	30.7	42
700≦R＜800							1,179	1.6	2	130	0.2	1			
800≦R＜900	9,063	18.5	11	6,337	14.3	9	5,171	6.9	13	2,225	3.2	7	4,266	7.7	10
900≦R＜1000							276	0.4	1						
1000≦R＜1100	3,541	7.2	6	1,865	4.2	6	3,213	4.3	8	5,287	7.7	12	16,665	30.2	35
1100≦R＜1200															
1200≦R＜1300	7,712	15.7	16	12,140	27.4	21	11,558	15.5	25	549	0.8	1	3,079	5.6	6
1300≦R＜1400															
1400≦R＜1500															
1500≦R＜1600	950	1.9	2	1,488	3.4	2	3,438	4.6	6	4,974	7.2	9	2,038	3.7	3
1600≦R＜1700															
1700≦R＜1800															
1800≦R＜1900	1,365	2.8	1				1,008	1.3	2				343	0.6	1
1900≦R＜2000															
2000≦R＜3000	6,071	12.4	12	7,528	17.0	16	6,360	8.5	15	1,385	2.0	4	4,296	7.8	10
3000≦R＜4000	220	0.4	1	2,611	5.9	5	77	0.1	1	416	0.6	1	5,273	9.6	14
4000≦R＜5000	573	1.2	1				160	0.2	2				183	0.3	1
5000≦R										1,952	2.8	3	1,187	2.2	4
Curve Total	49,007	100.0	93	44,277	100.0	79	74,772	100.0	183	68,955	100.0	178	55,184	100.0	128
Straight	153,596	75.8		155,458	77.8		112,644	60.1		113,338	62.2		484,901	89.8	
Curve	49,007	24.2		44,277	22.2		74,772	39.9		68,955	37.8		55,184	10.2	
Total	202,603			199,735			187,416			182,293			540,085		

Curve	Aleppo - Midan Ekbas			Mhine - Al-Sharqia			Old Qamishli - Al-Yaroubiye			Total		
	Length			Length			Length			Length		
R (m)	(m)	(%)	No.	(m)	(%)	No.	(m)	(%)	No.	(m)	(%)	No.
200≦R＜300										67	0.0	1
300≦R＜400				350	0.9	1				17,565	4.6	47
400≦R＜500	18,285	36.9	68							67,715	17.6	201
500≦R＜600	14,460	29.2	46	570	1.5	1	240	4.0	1	29,796	7.7	82
600≦R＜700	2,010	4.1	8	17,840	47.4	27				82,655	21.5	176
700≦R＜800										1,309	0.3	3
800≦R＜900	4,500	9.1	15	2,910	7.7	6				34,472	8.9	71
900≦R＜1000										276	0.1	1
1000≦R＜1100	6,770	13.7	19	2,630	7.0	3	1,165	19.5	4	41,136	10.7	93
1100≦R＜1200										0	0.0	0
1200≦R＜1300				11,150	29.6	21				46,188	12.0	90
1300≦R＜1400										0	0.0	0
1400≦R＜1500										0	0.0	0
1500≦R＜1600	1,300	2.6	1							14,188	3.7	23
1600≦R＜1700										0	0.0	0
1700≦R＜1800	780	1.6	1							780	0.2	1
1800≦R＜1900										2,716	0.7	4
1900≦R＜2000										0	0.0	0
2000≦R＜3000	1,320	2.7	1	1,880	5.0	7	4,517	75.6	14	33,357	8.7	79
3000≦R＜4000	80	0.2	1	280	0.7	1				8,957	2.3	24
4000≦R＜5000										916	0.2	4
5000≦R							53	0.9	1	3,192	0.8	8
Curve Total	49,505	100.0	160	37,610	100.0	67	5,975	100.0	20	385,285	100.0	908
Straight	67,145	57.6		73,162	66.0		75,268	92.6		1,235,512	76.2	
Curve	49,505	42.4		37,610	34.0		5,975	7.4		385,285	23.8	
Total	116,650			110,772			81,243			1,620,797		

Note :

Exclude
Muslimia - Joban Bec
Exclusive Line
Short-cut Line

Table 3.3.2 Table of Gradient

Gradient	Jublin - Homs 2			Homs 1 - Damascus			Homs 1 - Tartous - Al-Kabil			Lattkia - Wdehi			Jublin - Old Qamishli		
	Length			Length			Length			Length			Length		
(‰)	(m)	(%)	No.	(m)	(%)	No.	(m)	(%)	No.	(m)	(%)	No.	(m)	(%)	No.
0≦G<1	40,675	20.1	65	31,491	15.8	52	42,913	22.9	87	35,375	19.4	56	193,445	35.8	196
1≦G<2	19,437	9.6	27	21,490	10.8	37	6,508	3.5	17	9,285	5.1	16	58,821	10.9	76
2≦G<3	7,615	3.8	19	22,098	11.1	46	14,786	7.9	31	7,816	4.3	15	68,138	12.6	80
3≦G<4	12,706	6.3	24	15,260	7.6	25	9,248	4.9	24	8,333	4.6	17	35,697	6.6	45
4≦G<5	9,767	4.8	17	14,770	7.4	25	7,762	4.1	25	6,177	3.4	15	28,250	5.2	35
5≦G<6	11,337	5.6	25	9,405	4.7	19	7,756	4.1	27	7,785	4.3	16	62,350	11.5	72
6≦G<7	15,415	7.6	29	9,760	4.9	24	7,243	3.9	19	16,213	8.9	24	72,323	13.4	81
7≦G<8	4,613	2.3	11	6,830	3.4	15	2,425	1.3	7	8,110	4.4	18	6,281	1.2	9
8≦G<9	8,760	4.3	16	12,630	6.3	28	4,266	2.3	11	8,335	4.6	14	14,780	2.7	14
9≦G<10	4,750	2.3	9	3,594	1.8	8	6,987	3.7	15	3,430	1.9	9			
10≦G<11	8,720	4.3	22	8,662	4.3	17	11,024	5.9	24	40,170	22.0	60			
11≦G<12	24,843	12.3	44	16,795	8.4	34	18,319	9.8	45	15,870	8.7	32			
12≦G<13	33,965	16.8	48	26,950	13.5	40	23,574	12.6	50	14,584	8.0	34			
13≦G<14							869	0.5	3						
14≦G<15							641	0.3	3						
15≦G<16							624	0.3	2	810	0.4	1			
16≦G<17							323	0.2	1						
17≦G<18							639	0.3	2						
18≦G<19							2,250	1.2	2						
19≦G<20							200	0.1	1						
20≦G<21							19,059	10.2	11						
21≦G<22															
22≦G<23															
23≦G<24															
24≦G<25															
25≦G<26															
Total	202,603	100.0	356	199,735	100.0	370	187,416	100.0	407	182,293	100.0	327	540,085	100.0	608

Gradient	Aleppo - Midan Ekbas			Mhine - Al-Sharqia			Old Qamishli - Al-Yaroubiye			Total		
	Length			Length			Length			Length		
(‰)	(m)	(%)	No.	(m)	(%)	No.	(m)	(%)	No.	(m)	(%)	No.
0≦G<1	24,267	20.8	28	13,762	12.4	27	30,468	37.5	39	412,396	25.4	550
1≦G<2	1,920	1.6	3	5,252	4.7	9	10,990	13.5	12	133,703	8.2	197
2≦G<3	7,286	6.2	9	5,965	5.4	13	8,055	9.9	11	141,759	8.7	224
3≦G<4	3,085	2.6	4	5,590	5.0	15	4,050	5.0	5	93,969	5.8	159
4≦G<5	2,900	2.5	5	8,857	8.0	20	7,180	8.8	8	85,663	5.3	150
5≦G<6	9,257	7.9	10	3,400	3.1	8	3,650	4.5	5	114,940	7.1	182
6≦G<7	6,060	5.2	6	5,310	4.8	13	7,350	9.0	5	139,674	8.6	201
7≦G<8	2,220	1.9	3	2,450	2.2	4	2,400	3.0	2	35,329	2.2	69
8≦G<9	2,055	1.8	3	5,350	4.8	13	6,300	7.8	5	62,476	3.9	104
9≦G<10	2,180	1.9	4	1,836	1.7	5				22,777	1.4	50
10≦G<11	14,592	12.5	6	6,050	5.5	9				89,218	5.5	138
11≦G<12	901	0.8	1	23,475	21.2	39				100,203	6.2	195
12≦G<13				23,475	21.2	31	800	1.0	1	123,348	7.6	204
13≦G<14	3,824	3.3	4							4,693	0.3	7
14≦G<15	930	0.8	1							1,571	0.1	4
15≦G<16	1,162	1.0	2							2,596	0.2	5
16≦G<17	3,098	2.7	2							3,421	0.2	3
17≦G<18	1,600	1.4	2							2,239	0.1	4
18≦G<19	4,199	3.6	3							6,449	0.4	5
19≦G<20	3,412	2.9	3							3,612	0.2	4
20≦G<21	3,290	2.8	1							22,349	1.4	12
21≦G<22	525	0.5	1							525	0.0	1
22≦G<23	4,717	4.0	3							4,717	0.3	3
23≦G<24	5,727	4.9	7							5,727	0.4	7
24≦G<25	1,000	0.9	1							1,000	0.1	1
25≦G<26	6,443	5.5	4							6,443	0.4	4
Total	116,650	100.0	116	110,772	100.0	206	81,243	100.0	93	1,620,797	100.0	2483

Note :

Exclude
Muslimia - Joban Bec
Exclusive Line
Short-cut Line

3.3.3 Status Quo of Permanent Way Facilities

Major facilities of permanent way are as follows:

Railway Route Length	1,792km (1,540km)
Number of Track	Single Track
Number of Station	102 Stations
Number of Curve & Length	(888places, 379km)
Number of Gradient & Length	(2,390places, 1,158km)
Number of Bridge & Length	602, 21.8km
Number of Tunnel & Length	12, 7.5km

Note : The figures ( ) exclude Muslimia – Joban Bec, Exclusive Line, Short-cut Line

(1) Track

1) Rails and Switches

The rails laid over the line section constructed since 1970s are of P50 (50 kg/m) as defined per Russian Standards and its unit length is 25 m. Over the route between Aleppo and Midan Ekbas and the route between Old Qamishli and Al Yaroubiye constructed during Ottoman Empire, P43 rails (43 kg/m) have been laid, and these rails have not been replaced since the time of rail installation unless the rails are damaged due to accident/s or other factors.

Switch # 11 per Russian standard with P50 rails have been installed on main line while switch # 9 with the same type of rails installed on sidings.

2) Sleepers and Fastenings


Switch

Over the route constructed since 1970s, concrete sleepers have been placed. For rail fastenings, GESR initially adopted Russian Standard K2 tie plates. However, due to aging, initial wooden tie plugs are no longer suitable for secure tightening of bolts, therefore, replaced with plastic tie plugs. Since then, French made Rn and Russian Standard K6 have been adopted. Since a suitable type of fastening device to meet the GESR's requirements has not been determined yet, an alternative-fastening device is under study.

Concrete sleepers are being manufactured at General Company for the construction of Syrian Railways; its capacity is 200,000 units/year, which is sufficient for the supply.

3) Ballast

Over the route constructed since 1970s, crush stone ballast have been placed, except earth fill roadbed on the route constructed prior to 1970s.

(2) Maintenance Condition

1) Track

The condition of track maintenance is generally good, however, compaction of ballast at rail joints is not sufficient. Rolling stock is subject to pitching (up-and-down movement) when passing over the joints. Between Mhine and Al Sharqia, sleepers at rail joints were replaced together with carrying out proper track maintenance. Since then the condition has been rectified. It is recommended to do the similar maintenance work in other sections. Since rail fastening bolts for concrete sleepers have not been properly tightened, sleepers are not fastened rail at rail joint side at numerous locations. Also, rail pads are lost due to vibrations at many places. Track maintenance has been carried out with large track maintenance machinery; however, large irregularities in alignment and level were observed (due to lack of standards and criteria for track maintenance).

As the maintenance of switches has not been properly carried out, speed restrictions have been imposed over straight track. In some locations, a large gap is seen between tie plates and tongue rail on which tongue rail is laid, thus the whole of switch is not properly leveled. Wooden sleepers for switches are not adequately placed, as there are gaps between dog spikes and tie plates. There are allegedly accidents occurred due to insufficient maintenance of switches, however, no records of the cause of accidents was made available to the JICA Study Team.

2) Roadbed

Over the line section constructed after 1970s, in particular on embankments, sufficient roadbed width has not been secured and there are observed many places where ballast is falling down from the end of sleepers to the slope of embankments. Provided that width of shoulders is secured, an allowance of about 60 cm should be available at both sides, however not available due to increased ballast depth under sleeper bottom and failure of slope shoulder.

An area of approximately 40 km in length including Jawaief station between Al Jazira and Abu Fas was heavily damaged by sandstorms; railway tracks are frequently buried

during the transition of seasons (from dry season to rainy season, vice versa). About one meter depth of sands are piled up in a day or so, thus the Railway is struggling for a countermeasure. Especially in cut sections, such an adverse effect is evident. Although various steps are taken to solve this problem by cutting off the surface of cut sections, or planting trees in the surroundings, yet, no decisive measure is found so far.

3) Railway Markers

Kilometer posts are generally installed at designated locations but 100m posts and 500m posts are installed on limited section. Gradient posts are partially installed, however, almost every one of them is illegible. Markers indicating the beginning of curve and the end of curve are rarely installed. These markers are criteria for track maintenance and are essential for train operations as well.

4) Level Crossings

Level crossings and adjacent tracks are not properly maintained causing large vibrations upon train passing. In terms of structure, pavement and others at roadside are well maintained while railway side is not capable of maintenance freely. Also, level crossing width is narrower than the road width at numerous locations thus affecting adversely the passing through the road. In addition, there are a number of private level crossings built by surrounding inhabitants, which have impaired train operations.

5) Others

At some line section where farm products are cultivated, ballast between sleepers was removed for installation of water pipes for irrigation at many locations.

3.3.4 Railway Structures

Bridges, tunnels and structures crossing the railway are as shown in Table 3.3.3.

Table 3.3.3 Railway Structure

	Station to Station	Bridge		Tunnel	Drain	Remarks
		Concrete	Metal			
1	Lattakia – Tartous	23			167	
2	Tartous – Akkari	13			9	
3	Akkari – Homs 2	21			98	
4	Homs 2 – Sneisel	4			14	
5	Sneisel – Abu Dhour	37			69	
6	Abu Dhour – Wudehi	27			23	
7	Wudehi – Aleppo	16			42	
8	Wudehi – Lattkia	89	14	8 (Concrete)	154	
9	Homs 1 – Mhine	24			27	
10	Mhine – Al-Shrqia	64			200	
11	Mhine – Damascus	109			177	
12	Aleppo – Midan Ekbas		13	4 (Stone)	237	
13	Jubrin – Al-Sadaqa	21			56	
14	Al-Sadaqa – Al-Karama	19			56	
15	Al-Karama – Bir Juwaief	21			147	
16	Bir Juwaief – Old Qamishli	32			139	
17	Nusaibin – Al-Yaroubiye	6	8		55	
Total		567	35	12	1,670	

(1) Bridges

All bridges located between Aleppo and Midan Ekbas and those between Nusaibin and Al Yaroubiye as built during the end of the Ottoman Empire are erected with steel girders. As for steel girders, 3-span continuous deck truss, and through truss with a span of 74m or spans of 21 to 50m have been constructed. The bridges were designed with a 17-ton axle load by German technology during the aforesaid age, which have now caused a problem to introduce large traction force locomotives.

The bridges on the lines section constructed after 1970s have been designed with a 25-ton axle load with concrete girders with a variety of spans of 3.0 to 34.2m; composite girders with varying spans of 16.5 to 34.2m have been used at mountain regions crossing deep gorges.

Haradara Bridge

Although the concrete girders are aged more than 20 to 30 years, most of them are relatively in a good condition. Although main reinforcing bars are partially exposed due to a shortage of minimum concrete cover during the construction, and cracks were observed along the main reinforcements, these failures are not susceptible to a rapid malfunction to the bridges. The designed function of bridges can be sustained by making periodic remedies under a cautious planning.

(2) Tunnels

A total of 12 tunnels consisting of four between Aleppo and Midan Ekbas and eight between Wudehi and Lattakia have been driven. The former tunnels are constructed of stone masonry while the latter constructed of concrete. The breakdown is as shown in Table 3.3.4.

Table 3.3.4 Table of Tunnel

	Station to Station	Km - km	Length (m)	Quality	Remarks
	Lattakia Line				
1	Jisr Elshogour ― Budama	134 - 135	1,101.51	Concrete	
2	Jisr Elshogour ― Budama	137 - 138	625.80	Concrete	
3	Budama ― Bibar	147 - 149	1,862.90	Concrete	
4	Bibar ― Sheikhana	151 - 151	296.00	Concrete	
5	Bibar ― Sheikhana	161 - 161	291.50	Concrete	
6	Bibar ― Sheikhana	161 - 161	206.00	Concrete	
7	Bibar ― Sheikhana	162 - 163	495.00	Concrete	
8	Sheikhana ― Al-Kabir	177 - 179	1,600.00	Concrete	
	Sub Total		6,478.71		
	Midan Ekbas Line				
1	Midan Ekbas ― Rajo	557 - 557	130.00	Stone	R=400
2	Midan Ekbas ― Rajo	563 - 563	165.00	Stone	R=400
3	Midan Ekbas ― Rajo	565 - 565	540.00	Stone	R=400
4	Afrin ― Qatma	606 - 606	235.00	Stone	R=400
	Sub Total		1,070.00		
	Grand Total		7,548.71		

3.3.5 Track Maintenance

(1) Standards and Criteria

Track maintenance has been carried out according to Russian Standards. Regarding respective items, evaluations are made dividing into five different ranks, and where it exceeded “Rank 3”, maintenance has to be carried out.

Various items are shown in Table 3.3.5 (1) and (2).

Table 3.3.5 (1) Gauge

(Unit : mm)

Rank	Gauge (－)		Gauge (＋)			
	1435	1445	1435 R≧350	1445 349≧R≧300	1450 R≦299	1455
1	1 – 4	1 – 4	1 – 8	1 – 8	1 – 8	1 – 6
2	5 – 6	5 – 10	9 – 11	9 – 11	8 – 11	―
3	7 – 8	11 – 12	12 – 16	11 – 16	―	―
4	9 – 10	13 – 14	16 – 26	―	―	―
5	Over 10	Over 14	Over 26	Over 16	Over 11	Over 6

Table 3.3.5 (2) Longitudinal Level, Torsion, Cross Level and Alignment

(Unit : mm)

Rank	Longitudinal Level (*)	Torsion (* *)	Cross Level	Alignment (*)
1	1 – 10	1 – 8	1 – 6	1 – 3
2	11 – 15	9 – 12	7 – 12	4 – 5
3	16 – 20	13 – 16	13 – 16	6 – 7
4	21 – 25	17 – 20	17 – 20	8 – 9
5	26 – 35	21 – 30	21 – 25	10 – 17
	Over 35	Over 30	Over 25	Over 17

Note: (*) over 20m chord (* *) 5m interval

Maintenance Machine

(2) Maintenance of Way System

Maintenance of way system is composed of 1 Bureau, 7 Departments, 18 Divisions at Headquarter in Aleppo, while 3 regional Bureaus i.e., (North, East and Central Bureau), 10 Maintenance of Way Offices under regional Bureaus, and 32 sub-districts with 92 gangs along the line are responsible for the maintenance of way.

The number of regular staff is 224 in the headquarters, 92 in the regional bureaus, and 2,920 in the maintenance of way offices totaling to 3,236. The responsible range of respective gangs is extended to 20 to 25 km, and 9 to 12 gangers are deployed at each location. Gangers and watchmen are deployed at 92 locations and its total number is 1,016.

(3) Maintenance Material Volume

An annual average volume and quantities of materials used for maintenance per 1 km of track length classified by type are as shown in Table 3.3.6.

Table 3.3.6 Annual Quantity of Material Used for Maintenance

Description	No. Per Track 1 km
Steel Sleeper	2
Concrete Sleeper	5
Wood Sleeper	50
Rubber pad with Steel plate	10
Fishplate	6
Fastening Bolt & Nut for Sleeper	40
Fastening	3

The annual volume of ballast and sand used for maintenance on whole network is 35,000 m^3 and 9,000 m^3 respectively.

(4) Maintenance of Way Machinery and Equipment

2 self-propelled track geometry cars are on hand, however, one of them is outdated and merely used for the transport of gangers. The other one runs through the entire line inspecting the track geometry once every six months. The results of inspections and measurements are notified to respective depots for the planning of maintenance of way. However, statistical analyses are not conducted of those data gained by the track geometry-recording car for the management of respective track conditions.

Although large heavy-duty machinery is allocated for maintenance of way, those introduced at the onset of construction in 1970s are now deteriorated thus not useful any more. Existing machinery controlled by the headquarters is organized into a mechanized gang and actively performing the required work at strategic points.

3.3.6 Education/Training

(1) Education/training in Railway Academy

Education/training requested by the headquarters are being carried out for the railways employees to enable them to master technical know-how at the training center of the Railway Academy as described in Table 3.3.7.

Table 3.3.7 Details of Education for Railway Facilities

Courses	Educational Background	Experience in years	Course Duration	Remarks (Purpose)
Gangers	4 to 6 years	―	17 weeks	Newcomers
Upgrading of Gangers	6 to 9 years	1 to 5 years	9 weeks	Retraining
Maintenance Vehicle Drivers	Ditto	2 to 5 years	9 weeks	Promotion
Foremen	Ditto	―	43 weeks	Promotion
Upgrading of Foremen	Ditto	1 to 5 years	13 weeks	Retraining
Upgrading of Gang Chiefs	12 years	1 to 5 years	13 weeks	Promotion
Upgrading of Gate Keepers	3 to 5 years	1to 5 years	4.5 weeks	Promotion

Educations/training is not conducted for new technology and for the case when new machinery introduced. There is also a problem in recruiting qualified engineers capable of giving lectures in the training center.

(2) On-the-Job Training at Job Sites

Allegedly, on-the-job trainings are not carried out at job sites to learn the technical know-how for track maintenance.

3.3.7 Securing Safe and Stable Transport

Existing facilities and provisions are the same as those under which trains (passenger 120 km/h and freight 100 km/h) were operated during the initial age after construction. Since

satisfactory maintenance of way has not been carried out, speed restrictions are inevitably imposed on some sectors. Problems to be solved in the future to resume design speeds and to maintain safe and stable train operation are as described below:

(1) Urgent Matters

1) Remedy to the low rail joints

Replacement of sleepers where rail fastening is not possible, straightening of rails, placing sufficient volume of ballast and compacting with a tie-tamper to prevent up-and-down movements (vertical movement) and at locations where ballast is consolidated, replacement with new ones.

2) Rectification of Switches

Ballast of switches on the main line are consolidated and the level is not even. All the ballast should be replaced, securing designed ballast depth and then compacted properly. Replace damaged and defective parts of the switch with new ones, securing designed dimensions of each part.

3) Maintenance of Level Crossing and Securing Safety

Almost no maintenance is carried out for the track at level crossings, ballast under the sleepers is consolidated and maintenance standards are not complied with. In an extreme case, the alignment at both sides of level crossing is inappropriate. Removing all the pavements of level crossings, replacing all the ballast, the structure should be altered to a type so as not to receive all the road traffic loads directly upon the track skeleton at level crossings.

All the trains passing through level crossing reduce the train speeds in Syria. It should be noted that trains in advanced countries run through level crossings at normal speeds.

A decisive legislative rule should be applied to the passing of motor vehicles at level crossings; on the other hand, the Railway side should take necessary measures required for the legislation such as provision of necessary warning signs and marking for the protection of accidents.

(2) Improvements of Maintenance of Way

1) Modernized Control of Track Geometry

The entire track geometry is inspected with a track-recording car once every 6 months. Based on the results, maintenance of way is carried out, however, the results of the inspections are not fully utilized. Since no indication is made to the control limits line for respective items to be measured, failures exceeding slightly the limits are presumably overlooked, although a large irregularity could be easily detected. A system should be established to control statistical values by which the most recent results of measurements could be readily compared with the previous measurements.

2) Preparations of Track Management Log

Although profiles were available to the Study Team under this survey, those are the data used at the time of construction stage; depending on the locations, several different kinds of drawings were furnished. It was difficult for the Study Team to understand which drawing was appropriate one for existing condition.

When the Study Team surveyed the work carried out by mechanized gang at site, the maintenance was carried out targeting at the good maintenance level of the nearby track, therefore the maintenance standard level was varied depending on the locations.

It is necessary to establish an absolute standard by which track maintenance should be performed. It seemed that the original alignment as constructed was not maintained due to placing of additional ballast for remedy. Surveying should be carried for the entire route, setting up a new alignment, recorded on the log, and then maintenance should be carried out based on the standard values on the log.

3) Setting up Track Maintenance Plan

A survey was made to the maintenance plan throughout the year for track and related facilities. It revealed that only maintenance was aimed at defects and failures without indicating any intentional annual plan for the work.

This fact is probably due to the limited number of workers i.e. 10 or so allocated for a work range (average track length of 30 km). Under such a condition, maintenance as planned cannot be possible except for only urgent remedies as required.

Although large machinery is deployed at each line maintenance depot, it is assumed that they are not fully capable of meeting the requirements because of aging. It is necessary to reorganize the system with incorporating new heavy-duty machinery together with deploying a larger mechanized gang to enable them to perform intended

maintenance work. In connection with this step, on-the-job training especially for chiefs of gangs should be thoroughly made and line maintenance work should be standardized.

Since track conditions considerably vary depending on the district, Superintendent of Track Maintenance Depot who controls the district should be given an authority.

4) Preparations of Civil Engineering Structures Log

Most of the structures are aged more than 20 to 30 years. These structures will be further deteriorated rapidly in the near future, thus an increase in repairs is most likely. Especially in concrete structures, large cracks and spalling of concrete exposing reinforcing bars to weather were observed. It is recommended that current conditions of respective types of structures be logged in for the control as soon as possible.

Regarding earth-fill structures and embankments in particular, roadbed width is insufficient at numerous locations. As an extreme case, ballast fell out of the end of sleepers over embankment slope.

3.4 Signal and telecommunication system

3.4.1 Signal system (the present situation)

Signal equipment and devices to constitute the GESR signal system are divided into two main types.

Type 1

This type1 of signal equipment and devices were installed at the end of 1969,and has been used since 1971 for the section between Lattakia and Allepo, Allepo and Qamishli. (Fig 3.4.1)
This type adopts a blocking system between stations. Track circuits (DC) are installed only at the entrance/exit of the stations.
However only in the major stations having complicated track layout such as Allepo and Jubrin, the track circuits (AC) are installed for all the tracks in the station area , besides for the track at the entrance/exit of the station , and the switches are handled and checked by the switch machine(DC 160V) remotely from the center of the station even in this Type 1.

Type 2

This type of signal equipment and devices were installed at the beginning of 1980, and has been used since 1982 for the section between Hamidia and Damascus (F), Homs and Tartous, Mhin and Al-Sharqui.
This type also adopts a blocking system between stations.
The track circuits (AC) are installed for all the tracks in the station area, besides for the track at the entrance/exit of the station, and the switches are handled and checked by the switch machine (AC380V) remotely from the station master’s room.

The Table 3.4.1 shows the summary of signal equipment of the GESR.

Table 3.4.1 Summary of Signal Equipment of the GESR

Equipment	Kind	Lattakia Qamishli	(Allepo) Midan Ekbas	Tartous (Homs)	(Mhine) Al-Sharqia	(Aleppo)* Damascus	(Lattakia) (Tartous)	(Qamishli) Al-Yaroubiye
	Line length (km)	740	117	96	110	395	99	51
(number of equipment)		**Type1**	no signal equipment	**Type2**	**Type2**	**Type2**	no signal equipment	no signal equipment
Corour light signal		624		184	103	452		
Track circuit	AC	184		164	112	480		
	DC	196						
Interlocking	R.I. Concentrated	5		8	4	22		
	C.K. Dispersion	34						
Switch	Power,remote(DC)	171						
	(AC)			115	60	277		
	manual,local	285						
Signal Equipment at Level crossing		1		1	14	4		

*except Ansari Wudehi

3.4.2 Telecommunication System (the present situation)

Telecommunication equipment and devices of GESR are installed along all their railway lines and are divided into three main types.

Type 1

As for telecommunication wired line, 8 lines of over head bare wire are installed and used in the section between Lattakia and Allepo,Aleppo and Qamishli, 4 lines of over head bare wire are installed in the section between Allepo and Midan Ekbas. (Bare Wire Section)
These lines were constructed at the end of the1969 and have been used since 1970.

Type 2

Telecommunication cables (7Q1.4mm) are buried in the ground along the section between Aleppo and Damascus (F), Tartous and Homs, Mhine and Al-sharqia. (Cable Section)
These cable lines were constructed at the early 1980's and have been used since 1982.

Type 3

There is no telecommunication wired line in the section between Qamishli and Al-Yaroubiye, Lattakia and Tartous. (No Wire Section)
The radio communication systems have been constructed using frequency band of 400MHz since 1993 for the local communication links between the neighboring stations, station and train crew, and are used in the almost all section of the GESR.

The Table 3.4.2 shows the summary of the telecommunication equipment of the GESR.

Table 3.4.2 Summary of Telecommunication Equipment of the GESR

Equipment	Kind	Lattakia Qamishli	(Allepo) Midan Ekbas	Tartous (Homs)	(Mhine) Al-Sharqia	(Aleppo) Damascus	(Lattakia) (Tartous)	(Qamishli) Al-Yaroubiye
	Line length (km	740	117	96	110	395	99	51
		Type1	**Type1**	**Type2**	**Type2**	**Type2**	**Type3**	**Type3**
O.H.bare wire	8lines	740						
(km)	4lines		117					
Cable	7Q1.4mm			96	110	395		
PABXwithout network	without network	7						
	with network	1		2	1	4		
Carrier Terminal (set)				1		3		
Radio	Base Station	33	6	9	1	25	6	3
	Relay Station	8				3		
Dispatcher line		○ D1andD2	○ D1	○ D3	○ D4	○ D4	×	×
Block line		○	×	○	○	○	×	×
Station to Station line		○	×	○	○	○	×	×
Operator to Station line		○	×				×	×
Communication line for mentenance engineer		○	×	○	○	○	×	×

*except

3.4.3 Electrical Power Supply

The electrical power is supplied to almost all stations for the activating lights of the station, signal and telecommunication equipment or devices by either of the following three types of method.

Moreover for the case of power off, battery back up systems are prepared in signal and telecommunication system. The diesel generator is also provided in the major stations.

Type 1

The 20KV lines of the electric power company are led to the transformer in the station.

Type 2

The 20KV lines of the GESR diverged from the 20KV lines of the electric power company are led to the transformer in the station.

Type 3

The 20KV lines of the GESR from the substation of the electric power company are installed along the railway line and led to the transformer in the each station.

These lines have been constructed by degrees since 1976.

The Table 3.4.3 shows the summary of the power supply of the GESR.

Table 3.4.3 Summary of Power Supply Devices of the GESR

transformer capasity		Lattakia Qamishli	(Allepo) Midan Ekbas	Tartous (Homs)	(Mhine) Al-Sharqia	(Aleppo) Damascus	(Lattakia) (Tartous)	(Qamishli) Al-Yaroubiye
Line length (km)		740	117	96	110	395	99	51
(number of statioos)								
100KVA and the less	Type1	26						
	Type2	1						
	Type3	8		6	5	14		
200KVA-400KVA	Type1	4				1		
	Type2							
	Type3			1	1	5		
500KVA-1800KVA	Type1	2		1		1		
	Type2							
	Type3	1		1		2		
						*except Ansari Wudehi		

3.4.4 Maintenance system (the present situation)

Table 3.4.4 shows the number of electrical engineer stationed along the railway lines.

Table 3.4.5 shows training courses for electrical engineer provided in the training center of the GESR.

Table 3.4.4 Number of Electrical Engineer in the GESR

			Signal		Telecommunication		Electrical		Diesel Generater	
		Enginer	Technical assistant	worker	Technical assistant	worker	Technical assistant	worker	Technical assistant	worker
Division	Depot									
Head Office		13								
Aleppo		4								
	Maarret Ikhwan		2	3	5	2				
	Kafar Halab		1	3						
	Ansari		12	3	2		1	2		
	Aleppo		16	4	11	7	15	13	7	5
	Tel Rifaat				3	1				
	Qatma				2	4			1	1
	Jubrin		7	3	6	1	1	2		
	Sheikh Ahmad							1		
Lattakia		8								
	Lattakia		7	3	4	2	3	5		
	Sheikhana							2		
	Budama			1	1	3				
	Jisr Elshogour		2			2				2
	Mhambel		4		3	2	1			
	Bishmaroun		2	2	4		2			1
	Jabla				1	1		2		
Homs		4								
	Tel Kalakh							1		
	Al-Khanse				1			1		
	Homs		7	8	6	7	7	6		
	Kaarbettir						1			
	Mhine						1	2		
Damascus		8								
	Damascus(F)		7	3	3	2	1	1		
	Damascus(p)				5					
Hama		1								
	Hama		6	1	4	3	7			
	Qoumhane		1							
	Kafar Buhom		2							
	Sneisel		1		1		1			
	Abu Dhour			1	1			1		
Tartous		9								
	Baniyas				1	1	1	1		
	Tartous		6	2	6		4	1		
	Akkari						1			
Qamishli		4								
	Al-Sadaqa				1					
	Hneida		1							
	Raqqa		3	1	1	2	1	1		
	Deir el-Zor		3	4	2	3	3			
	Hassaka		3	2	2	3	3	1		
	Qamishli		5	4	4	5	2	4	2	

Table 3.4.5 Training Course of Electrical Engineer provided in the training center of the GESR

Training Course	qualification		weeks	hours
	experience	graduation		
signal				
worker levelup course1	1-5years	junior high school	5	136
worker levelup course2	1-5years	junior high school/high scool	17	476
technical assistant qualification course	1-5years	railway school	17	472
technical assistant levelup course	1-5years	high school	26	728
telecommunication				
worker levelup course1	1-5years	junior high school	6	136
worker levelup course2	1-5years	junior high school/high scool	17	476
technical assistant levelup course	1-5years	high school	13	364
electric				
worker levelup course1	1-5years	junior high school/high scool	9	252
technical assistant levelup course	1-5years	high school	17	476

3.5 Operation, Management and Financial Standings

3.5.1 Management Form

GESR is an independent enterprise, but it has a feature similar to one of the Government Organizations. GESR has not been granted subsidy from the Government to make up for the deficit, but the necessary funds for the projects with the approval of the Government are supplied with no interest. As a result, there is no problem of cash flow for GESR.

3.5.2 Financial Standings

(1) Accounting System

Both GESR and GEHR are handling accounting business according to the same general rule established by the Government. Roughly speaking there is no big problem in the rule in view of the general accounting principle.

(2) The Scale of Management

GESR almost concentrates on railway business, especially freight transport. The transport volume has followed the tendency toward the sharp decrease of passengers and the mild increase of cargo for nearly 10 years.

(3) Profit and Loss Status

Financial results of GESR recorded deficit every year from 1978 to 1996, but in 1997 revenue and expenditure were balanced and GESR recorded profitable results for two successive years in 1998 and 1999. According to GESR the reason of improvement is drastic cut of passenger transport operation. The financial statements for the year 2000 have not been announced yet, but the profitable results are expected. Increase of freight charge for 15% from October 12, 1996 also contributed to the improvement of profit and loss status.

From 1997 onwards, however, total personnel cost has been increasing and decrease of operating cost has mainly depended on cost of equipment, materials and others. One of the reasons why GESR could gain final profit is increase of interest earned and dividend from subsidiary in non-operating revenue.

Of these two factors increasing non-operating revenue, dividend from subsidiary will be expected to some extent as far as its management goes well, but the interest on deposit was caused from only temporary reason (delay of delivery of French locomotives).

(4) Indices for Management Analysis

From Balance Sheets and Profit & Loss Statements of GESR several indices for profitability, safety and productivity are calculated and the results are shown in Table 3.5.1.

Table 3.5.1 Indices for Management Analysis

ITEM	1995	1996	1997	1998	1999
INDEX FOR PROFITABILITY					
RATE OF RETURN ON TOTAL ASSETS (%)	-3.2%	-3.8%	0.0%	0.1%	0.3%
RATE OF RETURN ON EQUITY (%)	-12.2%	-18.9%	0.0%	0.7%	1.1%
RATE ON RETURN ON OPERATING REVENUE (%)	-26.0%	-28.6%	0.0%	1.0%	4.1%
TURNOVER OF OPERATING REVENUE ON TOTAL ASSETS	0.12	0.13	0.10	0.08	0.08
INDEX FOR PRODUCTIVITY					
TRANSPORT REVENUE PER EMPLOYEE (THOUSAND)	105.3	116.6	128.9	129.9	132.8
PASSENGER／TON･KM PER EMPLOYEE (THOUSAND)	177.3	179.4	167.7	152.3	163.7
INDEX FOR SAFETY					
RATE OF EQUITY ON TOTAL ASSETS (%)	26.3%	19.9%	13.2%	10.0%	30.4%

As for indices for profitability, turnover of operating revenue on total assets is at low level and gradually deteriorating. It is because GESR has so many Fixed Assets still not in work (Fixed Assets in Progress). This means that GESR cannot fully utilize its assets for acquiring revenue.

As for indices for productivity, transport volume per employee is decreasing. As it is difficult to fire an employee, once hired, it should be restrained to employ a person not in proportion to increase of transport volume. Rate of equity on total assets as index for safety went down every year until 1998, but in 1999 the new stocks for 3,373 Million Pounds were issued and fully paid-up by the Government.

(5) Break Even Point Analysis

Break Even Point is the point at which the sales (revenue) and the total cost used to acquire the sales are the same. Rate of Break Even Point on sales is called Break Even Point Ratio. The lower this Ratio is, the higher the profitability of the enterprise. To calculate Break Even Point all expenditures must be classified into fixed cost and variable cost. The former must be paid irrespective of the amount of sales and the latter varies in proportion to the sales. Break Even Point is obtained by following formula. In order to

lower Break Even Point and to make the profitable enterprise, it is necessary to cut fixed cost or to cut down the rate of variable cost on revenue.

$$X = F / (1 - V / R)$$

X = Break Even Point

F = Fixed Cost

V = Variable Cost

R = Revenue (Sales)

In this Report, all expenditures are classified into fixed and variable costs according to the rule adopted by NEEDS (Comprehensive Economic Data Bank System of Japan Economic Journal, one of the biggest daily economic newspapers in Japan) and then Break Even Point Ratio of GESR from 1995 to 1999 are calculated. Break Even Point of GESR was improved in and after 1997, but the level of Break Even Point Ratios is still high and stands at around 100%.

3.5.3 Organization and Personnel Arrangement

(1) Top Management

GESR is administrated under the Director General with assistance of the Deputy-Director General. There are two Committees. One is Executive Committee responsible for drafting management plans and the other is Business Committee checking whether the plan has been executed as decided every three months.

(2) Labor Union

The nationwide organization of Syrian labor unions is General Union of Workers under which is Union of Transport Workers. In each city there is Union of Railway Workers too, a subordinate organization to which all employees of the railway companies in the city belong. Workers take part in management of any enterprise by sending representatives of their union into Executive Committees. The unions have no right to go on strike, but companies have no right to dismiss the union members.

(3) Organization

GESR consists of Headquarters and three regional offices. Headquarters are divided into 17 divisions.

(4) Number of Employees

Table 3.5.2 shows the number of employees of GESR from 1995. During this period the transport volume of GESR remained almost at the same level, but the total number of employees increased about 10%.

Table 3.5.2 Number of employees (GESR)

DIVISION		1995	1996	1997	1998	1999	2000
1	Secretariat of Director General	79	85	83	85	85	87
14	Buildings & Track Division	142	146	150	153	150	152
17	Personnel & Legal Affarirs Division	64	59	65	65	64	63
9	Train Operation Planning Division	103	104	104	104	104	104
11	Signaling & Telecommunications Division	172	172	167	162	159	158
4	Designing Division	53	55	57	59	56	57
2	Inspection Division	9	9	9	10	9	9
13-1	Public Relations Department	62	49	47	55	59	59
10	Traction Division	760	683	731	803	893	886
3-1	Railway Institute	19	20	19	19	23	23
12	Automobiles Division	119	107	106	100	109	118
8	Marketing Division	27	26	27	28	22	19
13-2	International Department	9	8	7	8	8	8
6、7	Financial Division & Purchasing Division	249	235	241	240	247	243
5	Accounting Division	76	76	78	81	80	80
3-2	Training Center	108	106	114	119	119	122
15	Medical Division	22	21	21	20	21	22
16	Planning & Statistics Division	27	20	17	17	14	12
18-1	Eastern Regional Office	1,349	1,377	1,421	1,464	1,493	1,521
18-2	Central Regional Office	3,013	3,077	3,203	3,268	3,338	3,463
18-3	Northern Regional Office	3,559	3,687	3,654	3,721	3,725	3,794
TOTAL		10,021	10,122	10,321	10,581	10,778	11,000

3.5.4 Present Situation and Problems of Personnel Positioning

(1) Car Inspection Workshops and Depots

Compared with the present volume of work, these workshops and depots seem to be overstaffed.

(2) Station Personnel and Train Crew

1) Station Personnel

Judging from the number of trains, work volume and so forth, there is some room of capacity in the number of station personnel working at present in respect of both passenger and freight transport.

2) Train Crew

The present work systems of train crew will be reviewed as follows.

a) Abolition of Assistant Engine Drivers

It is considered that the engine driver alone can sufficiently take such actions as the confirmation of situation ahead of the train and identification of signal indications.

b) Passenger Train Crew

The contents of work of the crew will be reviewed in the future.

c) Freight Train Crew

The abolition of the crew in charge of freight consignor service will be studied.

(3) Personnel for Track Maintenance

In the present personnel organization for track maintenance, the number of middle and superior officers is too many compared with the workers in field organization. In promoting improvement of the network and extension of the route length, it is preferable that the present number of personnel should be kept by modernization of track maintenance technology and introduction of equipment for maintenance with high efficiency.

(4) Personnel in Electrical sector

At present the number of maintenance personnel for electric facilities is adequate if the present situation of electric facilities is kept as it is. However, to meet the increase in facilities, qualitative changes in facilities and so forth, it is necessary continuously to consider the employment, positioning, and training of young electrical engineers.

3.5.5 Education and Training

(1) Outline of Educational institutions

GESR's Middle Technical Institute of Railway and Education/Training Center are provided in Aleppo where various facilities and sidings are fully furnished.

① Middle Technical institute of Railway

Established, in 1974, under the control, by Ministry of Transport and Ministry of High-Education, high school graduates who passed common examination are

allowed to enter the Institute. The number of students is around 100 depending on the needs of GESR. The period of education is two years, and given a qualification as assistant engineer as graduated.

There are four courses, i.e., rolling stock, transport, facilities and signal/ telecommunications inc hiding on-the-job training for one month.

In addition to a principal, a vice-principal; four chiefs and four responsible teachers, lecturers are dispatched by GESR.

② Education/Training Center

Established in 1987 by the request from GESR for the purpose of level-up education their staff, training for new comers. As a special course, rolling stock, operations facilities, signal and telecommunications courses provided where practical education and training are being carried, out. On-the-job training is carried out at respective special workshops and training sidings. Also, computer course and foreign language (English) course are provided. The responsible staff of JESR plans training curriculums and periods.

As stated above, so far about 2,000 employees have graduated from, the Institute, while about 3,200 employees have completed training at the Training Center. However, lecturer, especially expert engineers are short, and training facilities and materials arc becoming out-of-date.

(2) Improvements to Education/Training

1) Overseas training, and dispatching of Engineers abroad

For upgrading the skills of employees in supervisory level, more overseas training should be conducted in the country where new materials purchased.

2) Enforcement of Conversion Education

For smooth deployment/reassignment of employees, training for other specialties should be carried out regardless of trainee’s qualification.

3) Introduction of Correspondence course

For expansion of a range in education/training, a correspondence course system should be incorporated.

4) On-the-job training

Organized on-the-job training should be carried out.

5) Provision of Customer Services Program

A curriculum for customer services should be the training program.

3.6 Business

(1) Outline of Business

The GESR's track records in 1999 was 848,000 passengers, 187 million passenger-kilometers, 5,445,000 tons of freight, and 1,577 million ton-kilometers. A total of revenue of 1,431. million Syria pound (equivalent toUS $ 31 .1 million or Japanese Yen 3,298 million) was achieved with both of passenger and freight traffic.

The GESR's traffic volume turned out to be lower since the investment law revised in 1991, in particular, passenger traffic has considerably decreased, affected by enhanced road network; development of motor vehicle i.e. sedans and buses.

On the other hand, freight traffic comprised of phosphorus ore, fuels, grains and others has steadily increased.

(2) Passenger

1) Outline of Passenger Trains

Passenger trains operations are three round-trips between Aleppo and Lattakia.

Other lines are one or two round-trips

International trains operated for Turkey and Iraq once a week.

2) Outline of System

① Tickets is inclusive of related services charges

② Fare Computation System The fares are classified by 1st class, 2nd class, Adult, Children, Discounted, and Sleeping Car.

3) Present Condition of Passenger Traffic

The traffic between Aleppo and Lattakia accounts for approximately 70%of the whole. On this line, the load factor floats between about 60 to 70%.Other lines have experienced in considerably lower load factors

(3) Freight

1) Outline of Freight Trains

The method of freight train operation is selected from that pre-scheduled diagram.

2) Utilization method of Wagons

The GESR owns about 5,000 wagons,of which excluding phosphate wagons are commonly used.

3) Outline of the system

① Freight Invoice The crew conveys the invoice to arrival station.

② Freight Fare There is five grades.

③ Exclusive Sidings Phosphate Corporation, Grains Corporation and Oil Refinery Corporation used these sidings.

④ Privately owned Wagon It is not well developed.

4) Present Condition of Freight traffic

The major commodities of freight are phosphate, fuels and grains.

(4) Connection with other transport sectors

It is extremely important in the rail transport service to maintain close connection with other transport sectors to offer convenient and secure services to passengers and shippers who utilize multiple number of transport means.

In the case of GESR in particular, there is no substantial connection with GESR for both passenger/freight as the train frequency between GESR and GEHIR is extremely limited; and track gauges of the two operators are different.

Nevertheless, if the two railways made improvements in terms of traffic increase and upgraded facilities, then traffic demand would increase in the future, adequate measures would be required in terms of train diagrams and various related systems.

As to the passenger services further, connection at major stations with road transport (bus/taxi, etc.), and furnishing and maintaining adequate loading/ unloading facilities at strategic freight. depots would be required.

(5) Current Problem Areas and Direction for Improvement

1) Passenger Business

① Changeover of Sales Stance

Since train frequency is less, timetables and sales brochures/pamphlets are not seen at station premises. A basic posture, as the passenger sales should be established.

Adequate station facilities (waiting rooms and toilets) should be furnished and kept clean always; interior and exterior of passenger coach should be cleaned to maintain neat appearance.

② Punctuality and Increase in Train Frequency

Safety and punctuality, which are the basis of rail services, should be secured, and trains frequency should be increased on certain lines.

③ Improvement to Sales System

Standardized products should be developed; dynamic sales promotion should be made for group tours.

④ Improvement to Customer Service Manners

Station employees working at ticket barriers, those at ticket windows, and train conductors, who are directly involved in the passenger services should be given thoroughly a practical knowledge for customer services, thereby, an attractive railways image could be infused into the public.

2) Freight Business

① Improvement to Transport System to regularly scheduled train operation

The current system by which, a train is selected from the pre-scheduled diagram should be altered to a system by which all trains are regularly scheduled for operations. Further, the speeds for shipping should be increased, and dates and times of arrivals should be clarified by operating a train for pre-designated shipment connection.

② Modernization of Transport System　Container transport

As a next phase, a strategic freight depot should be maintained orderly to handle containerized freight.

Provisions should be made for inland depots to cope with marine container.

③ Modernization of Freight Loading/Unloading System

Palletized freight and forklift should be incorporated.

④ Promotion of Private Wagon system

A system should be established for private wagon owners who use exclusive sidings. (Control of funds for manufacturing new wagons)

⑤ Modernization of Data Processing

Adequate measures with computers should be taken to control the following:

Shipping information

Online train control information, and Issuing freight invoice

⑥ Services to New Consignors

Since it is a precondition that head-office's approval required for shipments by new consignors, processing of paperwork should be simplified by entrusting station masters with a guarantee system for a certain type of commodity.

Chapter 4 Current Situation and Major Issues of GEHR

4.1 Brief History of the Hidjaz Railway

Religiously motivated, Sultan Abdul Hamid II of Turkey decided to build the Hidjaz Railway in 1900. Besides religious motivation, political, economic and strategic considerations also played a role.
The German railway engineer Dipl.-Ing.Meissner, who had been employed by the Turkish Railways since 1885, waschosen to supervise the construction of the railway.

Damascus, the terminal of the Beirut－Damascus 147km railway opened in 1894.
It had a gauge width of 1,050mm. Therefore, the same gauge was selected for the Hidjaz railway.
This made it possible for pilgrims to travel directly from the Mediterranean port of Beirut to the Holy Cities in Saudi Arabia.

There were sometimes as many as 7,500 soldiers loaned to the supervisor Meissner by the Turkish Government for construction work.
Austrian, Italian and Arab con-tractors as well as the soldiers were supervised by Meissner at the same time.

The main tasks of the contractors involved construction of structures such as bridges, stations, water towers and so on.
Most of the material for the structures was imported from France.
Most of the locomotives, coaches, rails and sleepers came from Germany.

When planning the alignment from Damascus to Medina, the pilgrims' path was selected for a large part of the route.
The numerous curves necessitated by the terrain brought the total length of the railway line between Damascus and Medina to1,303km.

Railway was designed for a maximum speed of 40km/h.
However, as the traveling speed was only about 25km/h, the journey from Damasucus to

Medina took about 55 hours.

The maximum capacity of the line was about 10 trains per day in each direction.

However, only 3 trains per week were normally operated.

4.2 Transport and business

4.5.1 Outline of train operating line

(1) Train operating line

There are 5 train operating lines in Hidjaz Railway.

The spans and situations are explained in the Chapter 4.4.

(2) The maximum train speed

The indexes of the train operating speed are as follows.

Daraa Line: Express is 50km/h, other/freight 35km/h

Surgaya Line: 30km/h

Qatana Line: 40km/h

(3) Present conditions of each line

Daraa Line: 4 stations among 9 en-route stations are closed.

Surgaya Line: 4 stations among 8 en-route stations are closed.

Qatana Line: 6 stations including terminus are closed.

Bosra Line: all 3 stations are closed.

Muzeireeb Line: all 3 stations are closed.

(4) Trains and train formations

There are no lines in which the trains are operated everyday.

One freight train per a week is operated in the Daraa Line.

On the Bosra Line, for two weeks in September during which Bosra festival takes place, one temporary train runs everyday between Damascus and Bosra.

The train formations are normally as follows.

Coach: 2～5wagons

Diesel car: 1 car

(5) Load factors

(a) Passenger train

Daraa Line: The factor is 40～50% in summer while 10% in winter.

Surgaya Line: The factor is 80% in summer (May through August) while nearly 0% in winter.

Qatana Line: The factor is 30% through the year.

(b) Freight train

Hauling capacity is 1500 tons (Rumania made DL).

(6) Accident

To compare with number of train operated, accidents are numerous.

In particular, collisions with trains over railway level crossings are evident.

4.2.1 Business

(1) Outline of Business

Statistics of 1999 shows that GEHR carried 94,000 of passengers and 1,916 tons of freight a year, and as a result , produced less than 3% of its total revenue.

GEHR has shifted their business activity from railway to a related business.

4.2.2 Issue of GEHR

(1) Ensure safety of train operation

Maintenance of railway level crossings and legislation of a law permitting a priority for train passing

(2) Service Improvement

Cleaning of rolling stock, setting up connecting trains with GESR trains and increase in frequency of operations as required.

4.3 Rolling stock and workshop

4.3.1 Current situation of rolling stock

1. Locomotive

Current number of locomotive (2000. June)

Type	Number of the book	Number available for use	Number under repair etc.	Rate available for use
SL	29	9	20	31
DEL	5	4	1	80
DHL	2	2	0	100

2. Diesel car

Current number of diesel car (2000. June)

Type	Number of the book	Number available for use	Number under repair etc.	Rate available for use
All	8	4	4	50

3. Passenger coach

Current number of passenger coach (2000. June)

Type	Number of the book	Number available for use	Number under repair etc.	Rate available for use
All	61	37	24	61

4. Freight wagon

Current number of freight wagon (2000. June)

Type	Number of the book	Number available for use	Number under repair etc.	Rate available for use
All	285	145	140	51

4.3.2 Current situation of workshop and depot

1. In Al-Qadam workshop, it needs respectively about one year for SL, three months for

DEL, one month for DC and two weeks for PC and FC.

2. Al-Qadam and Daraa depot carry out the daily inspection of all types of rolling stock.

4.3.3 Current situation of maintenance system of rolling stock and workshop

1. Inspection cycle and place

Type	Kind of inspection	Inspection cycle	Inspection place
SL	Before used	Before used	Depot
	Overhaul	1 (one) year	Workshop
DEL	Before used	Before used	Depot
	Mini-overhaul	180 hours or 8,000 km	Workshop
	Semi-overhaul	500 hours or 24,000 km	Workshop
	Overhaul	2,000 hours or 80,000 km	Workshop
DHL	Before used	Before used	Depot
DC	Before used	Before used	Depot
	Semi-overhaul	180 hours or 8,000 km	Workshop
	Overhaul	500 hours or 24,000 km	Workshop
PC	Before used	Before used	Depot
	Overhaul	3 months	Workshop
FC	Before used	Before used	Depot

4.3.4 Current major issues and improvement

(1) Rolling stock

It is necessary to utilize parts carefully that are now stocked.

(2) Workshop

It is necessary to construct the modern workshop that has modernized maintenance equipment devices.

4.4 Railway ground facilities

4.4.1 Track Facilities

(1) Outline of tracks

The main railway lines of the GEHR starting from the city center of Damascus extend to the respective directions and consist of the Daraa line, the Surgaya line, the Qatana line, etc.

The total length is about 265km.

The Daraa line(destined for Jordanian border) and the Qatana line(destined for military camps) are comparatively in good alignment.

The Surgaya line runs through mountain areas with upward consecutive steep slopes and small radii.

(2) Track facilities and situation of maintenance

As for the present situation about track maintenance, it is hardly to ensure satisfactorily maintain conditions of track because various issues to be cleared exist on the maintenance personnel and system, maintenance standard, track materials, working methods, maintenance machines and tools, maintenance technique and so on.

Since the track materials at the time of construction are still used for the Daraa and Surgaya lines, the current situations are maintained to the best of engineers' capability in light of the poor track materials.

Unified standards are needed for the sound maintenance of railway tracks and structural facilities.

Track maintenance standards are not prepared yet, albeit some goals to maintain track's gauge and cross level decided.

(3) Issues from now onward

The track facilities of the GESR have been used without any renewal; any improvement and/or rehabilitation since the time of construction, so that they have been getting older and deteriorated as time has gone on.

Particularly, the existing state of the track does not secure a satisfactory condition in light of the fatigued track materials and of the track maintenance.

It considered best limited to keep the status quo of the track under the circumstances of

the present track maintenance and conservation.

From now on, it is necessary to ameliorate the track facilities of a priority section set by the GEHR, inter alia, to facilitate the betterment with emphasis on the track.

4.4.2 Signal and Telecommunication Facilities

(1) Outline of electric devices

The main lines are constructed about 100 years ago and all the signal and telephone facilities are much aged.

Because of low density of train operation, block systems, signals in station, dispatching telephone, etc. are not introduced.

The switches are locked in more than half stations.

There are more than 200 railway level crossings without any protection device.

It is said that the 95% of railway accidents occur on the railway level crossings.

(2) Issues to be solved

It is necessary to install the protection devices on the railway level crossings whose traffic volume is large.

For speed-up of train operation, all the switches are to be improved.

4.5 Operation, Management and Financial Standings

4.5.1 Financial Standings

(1) The Business Structure of GEHR

Business of GEHR is divided into 5 categories including railway transport, but main line of business is real estate division. GEHR holds hotels, restaurants, cinema houses and office buildings for Ministries of the Government and the rental fees from these properties always occupy around half of its total revenue.

(2) Transport Revenue

In recent years GEHR has focused its energies on railway division, mainly operation of chartered trains for tourists and as a result both volume and revenue of transport are increasing. It is remarkable that the amount of miscellaneous revenue is very high, around 50% of total transport revenue. Main items included in miscellaneous revenue are fines collected from the car owners illegally parking their automobiles within railway premises and the rent for electric power lines, water pipes and telephone wires passing under railway tracks.

(3) Profit and Loss Status

To clarify the actual profit and loss situation of transport division, we divide total personnel cost of GEHR in1999 (59,448 thousand Syrian Pounds) into two in proportion to the number of employees in field organizations (470 persons) and Headquarters (140 persons). Personnel cost for field organizations is as follows.

59,448 × 470 ／ （470 ＋ 140）＝45,804 thousand Syrian Pounds

If this amount is regarded as personnel cost for transport division, fare revenue for 4,244 thousand Syrian Pounds covers only less than one tenth of personnel cost necessary for railway operation.

4.5.2 Operation and Management

(1) Management Form

GEHR is in as close relation with Syrian Government as GESR. Its capital is paid-up

100% by the Government.

(2) Number of Personnel

Number of employees of GEHR is increasing every year from 1995 to 1999. During this period growth rate of transport volume was high, but it is doubtful whether new employment in proportion to the increase of transport volume was indispensable or not.