

Chapter 4

Current Situation of Major Issues of GEHR

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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, was chosen to supervise the construction of the railway.

Damascus, the terminal of the Hidjaz Railway, was also the inland terminal of the Beirut – Damascus 147 km railway opened in 1894. It had a gauge width of 1,050 mm. 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.

The 464 km section between Damascus and Ma'an was opened on April 22, 1904. By 1906, the line had reached Tabuk. The official opening of the last section to Medina took place on September 1, 1908.

The technical achievements involved in the building of this line were considerable. In the years 1906 and 1907, for example, 228 km of railway line were built. 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 contractors 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. So did much of the other permanent way and ancillary equipment.

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 to 1,303 km.

The railway was designed for a maximum speed of 40 km/h. However, as the traveling speed was only about 25 km/h, the journey from Damascus 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.

Before the Hijaz Railway could be extended from Medina to Makka, the Turkish Government recalled Meissner, the supervisor, to assume responsibilities for the construction of other railways.

During the 1914 – 18 World War, the railway line was so badly damaged that operations were no longer possible on the southern section.

4.2 Transport and business

4.2.1 Outline of train operating line

(1) Train operating line

	Line Name	Section	Distance (km)	Remark
1	Al-Hijaz-Darra	Al-Hijaz- Darra	127.5	
2	Al-Hijaz-Sargaya	Al-Hijaz-Sargaya	58.0	
3	Al-Hijaz-Qatana	Al-Qadam-Qatana	27.2	
4	Darra-Bosra	Qam Garz-Bosra	33.68	
5	Darra-Al-Muzeireeb	Darra-Al-Muzeireeb	14.9	

(2) The maximum train speed

Passenger Trains

Darra Line Express 50km/h Other 35 km/h

Sargaya Line 30 km/h

Qatana Line 40 km/h

Bosra Line

Muzeireeb Line

Freight Trains

Darra Line 35 km/h

(3) Present conditions of each line

Darra Line: Passing loop (siding) at 4 stations among 9 en-route stations are closed.

Sargaya Line: Passing loop (siding) at 4 stations among 8 en-route stations are closed.

Qatana Line: Passing loop at 6 stations including terminus are closed.

Bosra Line: Passing loop at all 3 stations are closed.

Muzeireeb Line: Passing loop at all 3 stations are closed.

(4) Trains and Train Formations

Current trains operated and their formations are shown in Table 4.2.1(Figure indicates the number of round trip).

Freight train runs only once on every Tuesday on the Darra Line.

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

Table 4.2.1a Number of train operation

Line Name	Sargaya			Darra	Qatana	Bosra	Muzeireeb
	Al Hamah	Al Feejah	Sargaya				
	Afternoon	Morning	Morning				
Saturday	1	1			1	0	
Sunday	1	1	1		1	0	
Monday		1		1	1	0	
Tuesday	1	1	1	1(freight)	1	0	
Wednesday		1			1	0	
Thursday		1		1	1	0	
Friday		1	1			0	1
Remarks	DL+Pc × 2	SL or DL+Pc × 2	SL+Pc × 5 ~ 6	SL or DL+PC × 3 ~ 4	DC × 1		

Table 4.2.1b Train Time table

Darra line

Train No.	Origin Station		Terminus Station		Schedule Time	Schedule Speed	Operation day	Remark
	Station	Dp. Time	Station	Ar. Time				
411	Hijaz	8:00	Dara'a	10:41	2:41	47.5	Mon. Tus	DC 127.5km
B	Dara'a	11:15	Hijaz	13:57	2:32	50.3		

Sargaya line (6/1 ~ 9/15)

Train No.	Origin Station		Terminus Station		Schedule Time	Schedule Speed	Operation day	Remark
	Station	Dp. Time	Station	Ar. Time				
106	Hijaz	9:05	Feejah	10:00	0:55	23.4	Fri. Sat. Mon. Thu.	DL 21.4km
104	Hijaz	8:00	Sargaya	10:22	2:22	24.5	Fri. Sun. Tue. Wed	SL 58.0km
*	Feejah	*	Hijaz	*	*	*	*	*
*	Sargaya	14:50	Hijaz	17:24	2:34	22.6	Fri. Sun. Tue. Wed	SL 58.0km

Sargaya line (9/16 ~ 5/30)

Train No.	Origin Station		Terminus Station		Schedule Time	Schedule Speed	Operation day	Remark
	Station	Dp. Time	Station	Ar. Time				
104	Hijaz	8:00	Sargaya	13:30	5:30	10.6	Fri. Sun	SL 58km
105	*	*	*	*	*	*	*	*

Qatana line

Train No.	Origin Station		Terminus Station		Schedule Time	Schedule Speed	Operation day	Remark
	Station	Dp. Time	Station	Ar. Time				
91	Qadam	5:47	Qatana	6:25	0:48	24.3	Every day except Friday	DC 19.5km
92	Qatana	6:30	Hijaz	7:38	1:08	24.0		DC 27.2km

Darra line Freight train

Train No.	Origin Station		Terminus Station		Schedule Time	Schedule Speed	Operation day	Remark
	Station	Dp. Time	Station	Ar. Time				
411	Hijaz	7:20	Darra	11:05	3:45	34.0	Wed.	DL 127.5km
414	Darra	14:24	Hijaz	18:11	3:47	33.7		

Note: * Not provided

(5) Load Factors

(a) Passenger train

Darra Line: The factor is 40 to 50% in summer while 10% in winter

Sargaya Line: The load factor is 80 to 90% in summer (May through August) while nearly 0% in winter.

Qatana Line: The factor is 20 to 30% throughout the year

(b) Freight train

Hauling capacity is 1500 (Rumania made DL) but substantially is somewhat 200 tons hauling 11 to 12 wagons.

Traffic Volume records of are shown in Table 4.2.2.

Table 4.2.2 Traffic volume records

	Train km	Number of passenger	Passenger-Km	Tonnage	Ton-km	Car km		
						Loco.	Passenger car	Freight car
1994		16,542	413,550	2,402	338,682			
1995		62,940	2,580,130	600	84,600			
1996		78,922	1,703,580	1,691	238,431			
1997		85,333	2,143,921	2,350	331,350			
1998		99,809	1,970,352	1,907	268,887			
1999	1	1,146	30,204	24	3,384	3,411	4,348	2,728
	2	999	24,792	75	10,575	2,585	2,646	4,196
	3	2,489	73,082	137	19,317	4,485	9,000	7,966
	4	3,255	109,713	119	16,779	4,015	7,202	9,899
	5	7,496	239,555	370	52,170	8,328	16,298	20,022
	6	14,445	453,184	264	37,224	6,902	19,756	12,772
	7	16,110	507,293	136	19,176	10,750	27,590	25,350
	8	18,193	646,301	159	22,419	10,770	26,540	23,260
	9	18,408	904,892	114	16,074	11,048	28,648	28,360
	10	8,493	450,247	108	15,228	7,107	15,715	17,760
	11	2,230	69,302	214	30,174	7,100	15,375	17,477
	12	925	26,874	196	27,636	7,117	16,136	18,047
	Total	94,189	3,535,439	1,916	270,156	83,618	189,254	187,837

(6) Accident

Actual result accident during the period of January to May, 1999 is as Table 4.2.3.

Table 4.2.3 Actual result of accident

1999					
Month	Collision at Lever Crossing	Break down of rollin stock	Disturbanc e(Throw stones)	Other	Total
1	2		1		3
2	3		2		5
3			1		1
4	4	3	1		8
5	2	2	1		5

To compare with less number of train operations, accidents are numerous. In particular, collisions with trains over level crossings are evident.

4.2.2 Business

(1) Outline of Business

GEHR's records for 1999 amounted to 94,000 passengers, 3,535,000 passenger-kilometers, 1916tons of freight, 270,000 ton-kilometers that produce revenues which are less than 3% of the total revenue. The results of sales demonstrated a shift from railway business to a related business (real estate). See Table 4.1.3.

Table 4.1.3 Transportation Volume (GEHR)

		1995	1996	1997	1998	1999
NUMBER OF PASSEGERS	PERSONS	62930	78922	85333	99709	94189
	PERSONS-KM	2580130	1703580	2143921	1960352	3535439
TRANSPORTED FREIGHT	TON	600	1691	2350	1907	1916
	TON-KM	84600	238431	331350	268887	270156

GEHR runs only passenger trains twice a week and freight train once a week, in addition, runs group tour trains on Sargaya line for vacationers in summer.

Some lines have the possibility to serve as commuter lines for Damascus.

4.2.3 Issue of GSHR

(1) Ensure safety of train operation

1) Level crossing

Maintenance of Level Crossings

Legislation of a law permitting a priority for train passing

2) Strengthening of safety measures for rolling stock

Conversion of wooden-made passenger car to steel-structure

Conversion of vacuum brakes to automatic pneumatic brake

3) Provision of signal devices and telecommunication equipment and the strengthening of maintenance

Installation of train radios

4) Upgrading of track and the strengthening of track maintenance

(2) Service Improvements

1) Cleaning of rolling stock

2) Provision of junctions with GESR

Setting up connecting trains with GESR trains

3) Increase in frequency of operations as required

(3) The Improvement of Business

1) Since there are a number of historic sites along the railway routes, some of the lines should be designated as a sightseeing route.

2) Sales promotion should be made to encourage group tours.

4.3 Rolling stock and workshop

4.3.1 Current situation of rolling stock

Type of locomotives are steam locomotive (SL), diesel electric locomotive (DEL) and diesel hydraulic locomotive (DHL). SL are used since 1908 and DEL are used since 1973.

DEL are mounted with the direct current generator and the traction motors are the direct current.

Diesel car (DC) manufactured in the country of Hungary, are used since 1973.

Passenger coach (PC) which are made by wood, are used since 1908 and manufactured in the country of Hungary, are used since 1973.

Freight wagon (FC) are used since 1908.

Main particulars of rolling stocks of GEHR showed in Table 4.3.1.

Table 4.3.1 Main particulars of rolling stocks of GEHR

Type	Country where manufactured	Out put (HP)	Max. speed (km/h)	Axle weight (t)	Manufactured year
DEL	Rumania	1,510	100	12	1973
DC	Hungary	570	100	12	1973

(1) Locomotive

- 1) Number of locomotives on the books, available for use and under repair etc. as of June 2000 are shown in Table 4.3.2.

Table 4.3.2 Current number of locomotive (2000 June)

Type	Country where manufactured	Number on the books	Number available for use	Number under repair etc.
SL	-	29	9	20
DEL	Rumania	5	4	1
DHL	East Germany	2	2	0

- 2) SL and DEL are used for traction of both passenger and freight trains.

- 3) DHL is used as shunting.

4) Main failure of steam locomotive in 1999 are shown in Table 4.3.3.

Table 4.3.3 Main failure of steam locomotive (1999)

No.	Main failure contents
1	Wooden door failure (SL)
2	Axle shaft break (DEL)

(2) Diesel car

Number of diesel car on the books, available for use and under repair etc. as of June 2000 are shown in Table 4.3.4.

Table 4.3.4 Current number of diesel car

Type	Country where manufactured	Number on the books	Number available for use	Number under repair etc.
DC	Hungary	7	4	3
	France	1	0	1

(3) Passenger coach

1) Number of passenger coach on the books, available for use and under repair etc. as of June 2000 are shown in Table 4.3.5.

Table 4.3.5 Current number of passenger coach

Type	Country where manufactured	Number on the books	Number available for use	Number under repair etc.
PC (wooden)	-	35	23	12
PC (steel)	Hungary	26	14	12

2) Main failure of passenger coach in 1999 are shown in Table 4.3.6.

Table 4.3.6 Main failure of passenger coach (1999)

No.	Main failure contents
1	Wooden parts failure
2	Bogie spring failure

(4) Freight wagon

1) Number of freight wagon coach on the books, available for use and under repair etc. as of June 2000 are shown in Table 4.3.7.

Table 4.3.7 Current number of freight wagon

Type	Country where manufactured	Number on the books	Number available for use	Number under repair etc.
Flat wagon	-	179	93	86
Covered wagon	-	106	52	54

4.3.2 Current situation of workshop and depot

Workshop is located at Al-Qadam and depots are located at Al-Qadam and Daraa.

(1) Al-Qadam workshop

In Al-Qadam workshop, about 90 staff are carrying out the works followings:

Periodical maintenance/repair of all types of rolling stock of GESR.

Large scale temporary maintenance/repair such as replacement of wheel set and spring etc.

- 1) In Al-Qadam workshop, overhaul needs 1(one) month for SL, about 3 months for DEL, about 1 (one) month for DC and 2 weeks for PC and FC.
- 2) In Al-Qadam workshop, there are SL body shop, DEL and DC body shop, PC and FC body shop, casting shop and blacksmith shop etc.
- 3) Numbers of temporary maintenance/repair of rolling stock at Al-Qadam workshop in 1999 are shown in Table 4.3.8.

Table 4.3.8 Numbers of temporary maintenance/repair of rolling stock at Al-Qadam workshop

Type	Contents	Number
SL	Body relation	1
DEL	Bogie relation	1
PC	Body relation	1
	Bogie relation	1

(2) Al-Qadam depot

In Al-Qadam depot, about 20 staffs are carrying out the daily inspection of all types of rolling stock of GESR.

(3) Daraa depot

In Al-Qadam depot, about 10 staffs are carrying out the daily inspection of all types of rolling stock of GESR.

4.3.3 Current situation of maintenance system of rolling stock and workshop

(1) Organization

Current situation of maintenance organization is shown in Fig. 4.3.1.

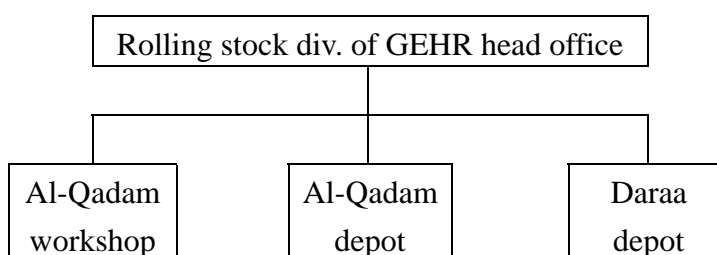


Fig. 4.3.1 Maintenance organization

(2) Inspection cycle and place

Current situation of inspection cycle and place of rolling stock are shown in Table 4.3.9.

Table 4.3.9 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

(3) Number of periodical inspection

Number of periodical inspection of rolling stock during 1999 are shown in Table 4.3.10.

Table 4.3.10 Number of periodical inspection (1999)

Type	Kind of inspection	Number
SL	Overhaul	0
DEL	Mini-overhaul	0
	Semi-overhaul	1
	Overhaul	0
DC	Semi-overhaul	1
	Overhaul	0
PC	Overhaul	16

4.3.4 Current major issues and improvement

(1) Rolling stock

1) Locomotive

As all the type of locomotive have been used for very long time, it is anticipated that procurement of major spare parts would become very difficult because manufacturers may stop production of these parts due to of their old fashioned types

2) Diesel car

As all the diesel cars have been used for very long time, it is anticipated that procurement of major spare parts would become very difficult because manufacturers may stopped production of the parts due to of their old fashioned types.

3) Passenger coach

Passenger coaches manufactured in Hungary may face the difficulty in procuring the necessary spare parts because manufacturers may stop production of such parts.

4) Freight wagon

Steel wagon may face the difficulty in procuring the necessary spare parts because manufacturers may stop the production of such parts. It is necessary to maintain carefully the existing parts and spare parts.

(2) Workshop and depot

- 1) Buildings of Al-Qadam workshop were constructed about 100 years ago. Therefore both buildings and machineries are very old. It is necessary to modernize them.

- 2) Modernization of Al-Qadam depot should be programmed combined with modernization of Al-Qadam workshop.

4.3.5 Education/Training

GESR does not have the training center which are trained the staff for rolling stock maintenance and inspection. Accordingly, planned education and training and on-the-job training are not carried out.

4.4 Railway ground facilities

4.4.1 Track facilities

(1) Track standards and facilities

1) Track standards

The track standard of GEHR was established for the construction of the Daraa line which is the oldest designed and constructed by French and German. This standard is applied to each railway line of which the main terms are as follows;

- Design maximum speed (different on lines)

Daraa line	35km/h
Surgaya, Bosra and Muzeireeb lines	30km/h
Qatana line	40km/h

-Gauge 1,050mm

-The minimum curve radius R= 100m

-The maximum cant C= 80mm

-The maximum gradient G=28‰

-Track formation width 3.5m

-Effective length of track at station 120m (300m for Al-Qadam and Daraa)

2) Track facilities

The GEHR railway network is shown in Fig. 4.4.1. The major track facilities of railways are as shown in Table 4.4.1.

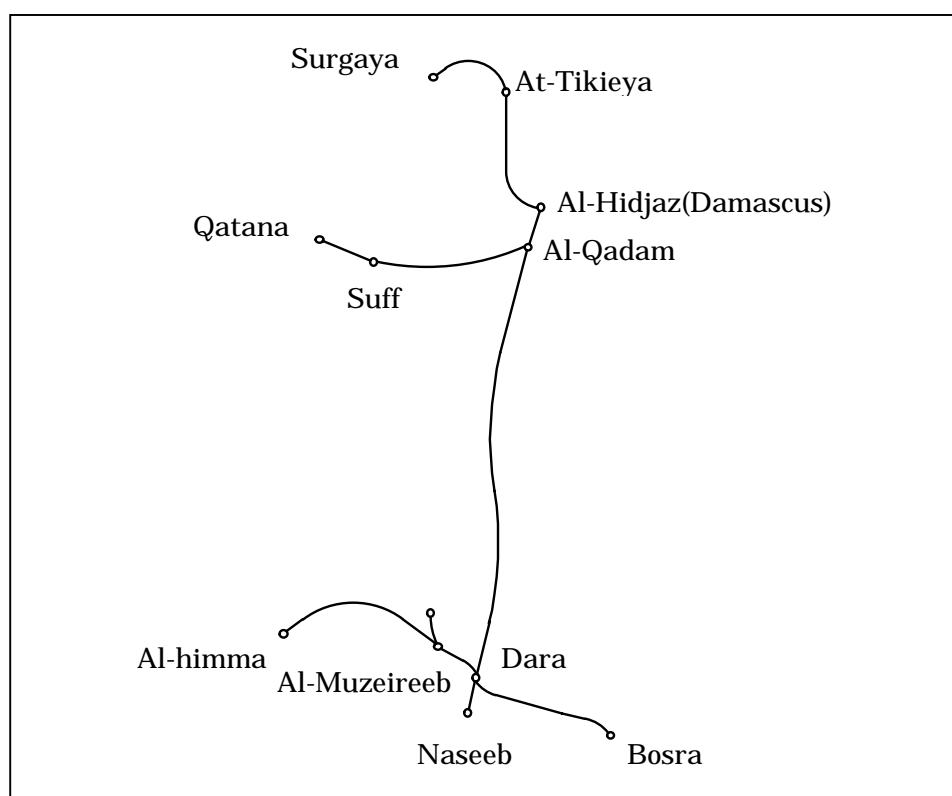


Fig. 4.4.1 GEHR railway network

Table 4.4.1 List of railway facilities

Item	Line section				
	Daraa line (except the section from Al-Hidjaz to Al-Qadam)	Surgaya line (except the section from Al-Hidjaz to the point of branching)	Qatana line (except the section from Al-Hidjaz to Al-Qadam)	Bosra line	Muzeireeb line
Length	123.2 km	57.2 km	33.5 km	39.5 km	11.9 km
Number of stations	13 (except Al-Hidjaz)	9 (except Al-Hidjaz)	8 (except Al-Qadam)	5	1
Number and length of curves	106 24.6 km	291 24.5 km	24 11.3 km	31 7.5 km	About 70% of line length
Number and length of gradients	158 81.0 km	107 45.7 km	*	8.1 km	*
Number of bridges(>=1m)	64	43	4	0	0
Number of tunnels	0	1	0	0	0
Number of level crossings	119	124	60	10	10

(The items shown by asterisk are unable to be confirmed due to a deficiency of drawings and/or data.)

(2) Alignment

The main railway lines of the GEHR starting from the city center of Damascus (Capital) extended to the respective directions have different characteristics in their alignments by line.

As to the Daraa line gently going down from Damascus to Daraa, the line has easy grades, mostly straight line sections and large-curve radii excluding the urban areas.

GEHR has also Bosra line extended to the east from Daraa and Muzeireeb line extended to the west from Daraa.

The Surgaya line runs through mountain areas with upward consecutive steep slopes and small radii in its alignment except Damascus city districts.

Alignment of the main railway lines is summarized as follows;

1) Al-Hidjaz-Daraa line

The Daraa line goes from Damascus southwards to Daraa station on a Jordanian border. Since Al-Hidjaz station is located about 700 m above sea level, the line creeps down from the suburb of Damascus through the gentle-undulating plateaus to Daraa, 530 m above the sea level. The gradients of the line are gentle in general through the line with the steepest slope of 18 ‰. The curve radius shows 250m as a minimum at around Ghazaalah and more than 300 m at the other sections.

Generally this line has a good alignment with the long-successive-straight line sections.

2) Al-Hidjaz ~ Surgaya line

Section of the line diverting from the Daraa line to Surgaya goes along and through the mountainous gorges with the steep gradients and the sharp curves in succession.

There are the comparatively gentle-upward gradients from Dummar to Al-Heejah.

The 13 km section from Al-Heejah to Al-Tikieyah has a poor alignment because it goes on along the mountains with small-curve radii from 100 m to 150 m and steep slopes

from 25‰ to 27.5‰.

Section of about 8 km from Al-Tikieyah has a good alignment with curve radii from 300m to 500m and gentle slopes running over the area of 1,100m above the sea level.

The 6 km section from Al-Zubdany to the point of 1,400m above the sea level has a poor alignment with steep slopes from 27.5‰ to 27.87‰.

The line section from the highest point to Surgaya has the downward slopes.

3) Al-Hidjaz ~ Qatana line

The Qatana line which bounds to the military base turning out from Al-Qadam has large curve radii because of recently being constructed.

This line section has a good alignment with main-curve radii from 400 to 800 m where there are many places with curves more than 1,200 m including only the two points with a small-curve radius of 300m.

There are many alignments with large-curve radii in the section from Al-Qadam to Saffu Ad-Dubbatu while from Saffu Ad-Dubbatu to the military base small curve radii are collectively adopted.

(3) Present track facilities

1) Track

The rails and sleepers being used now are summarized in Table 4.4.2

Table 4.4.2 Track materials

Track Materials	Line section				
	Daraa line	Surgaya line	Qatana line	Bosra line	Muzeireeb line
Rail	22 kg/m	22 kg/m	30 kg/m	22kg/m	22kg/m
Sleeper	Steel sleeper	Steel sleeper	Concrete sleeper	Steel sleeper	Steel sleeper

Remarks: Timber sleepers are used at turnouts and stations.

Concrete sleeper -----Domestic products (good stock)

Steel sleeper/timber sleeper-----Imported products (good stock)

a) Rail

Two kinds of rails are used. Their weights are 22k/m and 30kg/m whose standard lengths are 9 m or 12 m respectively. The 30kg/m rails are used for the Qatana line while the 22k/m rails are used for the other lines.

Since the existing rails of the Daraa and Surgaya lines are still the same-old rails as those being placed at the time of construction, the old rails have often been causing vertical and horizontal deformations and thus bringing about longitudinal level irregularities, lateral distortions and other irregularities.

b) Sleeper

Three kinds of sleepers are used. Those are concrete sleepers, steel sleepers and timber sleepers. For the Qatana line, domestic concrete sleepers are used, but for all the other lines imported steel sleepers are mainly used. Timber sleepers imported are used only for turnout and station areas and however are rarely used in the ordinary sections.

Usually, 1,350 to 1,500 sleepers/km are placed for tracks.

Concrete sleepers are still now stocked enough to be placed for 35km, which were produced at the time of the Qatana line construction. Substantial stock of imported steel and timber sleepers is observed.

c) Track bed

The Daraa and Qatana lines are constructed with ballast-bed tracks while the Surgaya line uses non-ballast soil beds for almost all places in the same manner as placed at the time of construction.

It is observed at many places that the ends of steel sleepers are exposed because of lack of ballast and/or the soil beds being washed out.

d) Maintenance

As for the present situation about track maintenance, it is hardly ensured to satisfactorily maintain conditions of tracks because various issues to be cleared exist on the maintenance personnel and system, maintenance standards, 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.

2) Level crossing

There are many level crossings. However, neither crossing signals nor crossing bars are installed at the level crossings between railways and many roads at grade.

Although check rails are provided at the level crossings for paved road section, few check rails and few pavement are liable to exist at the level crossings on and along unpaved roads.

It frequently occurs that pedestrians and cars are naturally crossing over in front of trains coming at the level crossings on the roads in the urban areas and on the main roads in the outskirts.

Occurrence of accidents at the level crossings is considered substantially possible, albeit trains are going slowly and/or gate keepers deployed before hand are instructing them to safely cross over.

It has clearly been ruled in the countries with advanced railway systems that the railway traffic takes precedence over the road traffic because trains cannot change directions nor stop quickly. It will be difficult to ensure safety for pedestrians, drivers and other passengers at the crossings without establishing the rules of the railway traffic taking precedence over the road traffic.

3) Structures along the railways

a) Bridges

Short bridges are main since the number of bridges is few and no big rivers exist.

Mostly those are through-steel-girder bridges which are not repainted well but observed to be little deteriorated due to corrosion.

The Surgaya line has a 16m-long short-deck bridge of the four spanned continuous arch type. Many small waterways with 0.3 m to 0.8 m wide cross the railways.

b) Tunnels

On the Surgaya line, there is only one tunnel which is 56m long. In light of the geographical features, the tunnel seems to have been constructed only at this place, albeit the line meanders through the face of mountains with successive small-curve radii. No apparent deterioration is found from appearances in the tunnel.

c) Earth structures

Embankments are 0.5 m to 1.5 m high in many sections, but are slightly observed to be 4 m to 5 m high at the sections near bridges.

Side slopes are so gentle that slope protection work and/or retaining walls are not constructed. The width of the railway right-of-way on one side from the center of the track is 6 m as a standard and the embankments remain their natural slopes in the most sections. It is found in some sections that track formation widths are not sufficient because of eroded shoulders and the ends of sleepers are exposed.

Cuttings concentrate on Suq Wadi Barada and near the tunnel in the Surgaya line. Cuttings are conducted by cutting natural grounds almost vertically where rocks and gobbles are found exposed on cut slopes without any protection works. No prevention nets nor works are found as countermeasures against stones and rocks falling down from upper slopes.

d) Protective facilities

Any facilities are almost not prepared for the protection of railway tracks.

In the city areas, residents can easily cross over the tracks from their houses built along the railway.

In the areas with roads running along railways and resort areas, it happens that pedestrians cross the railway tracks freely, cars are parked so closely to the tracks and/or even sheds are built near the tracks.

In the suburbs, it is frequently observed that flock of domestic animals cross the track.

In order to secure train safety operations and to prevent traffic accidents, protective fences and/or boundary fences are essential in the railway sections going into the city with not clear sights or where roads run in parallel with the railways.

In the Surgaya line running through mountainous areas, trains and train windows are prone to touch with plenty of trees along the line. Those trees have to be cut in order to ensure train safety operations and to prevent passenger's accidents.

e) Track sign posts

Important track-sign posts are not arranged for the sound maintenance of tracks.

Curved sign posts should be provided for the maintenance of tracks, albeit track kilometer posts and gradient signs are found, to secure a good track maintenance.

(4) Important maintenance line sections

Important arrangement should be provided for the section between Al-Masmeeyah and Izraa of the Daraa line where the ground is not good enough and subsides in succession. It is necessary to successively observe displacement of tracks and to record it as a datum. Results of the records are important data for establishing countermeasures.

(5) Present situation of railway maintenance

a) Track standards

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 are decided.

Allowable track irregularities are as follows.

-Gauge + 10 ~ 15 mm(-0 mm)

-Cross level ± 10 mm maximum cant = 80 mm

-Longitudinal level not prepared yet (to correct irregularities when happened)

-Alignment not prepared yet (to correct irregularities when happened)

b) Maintenance work system

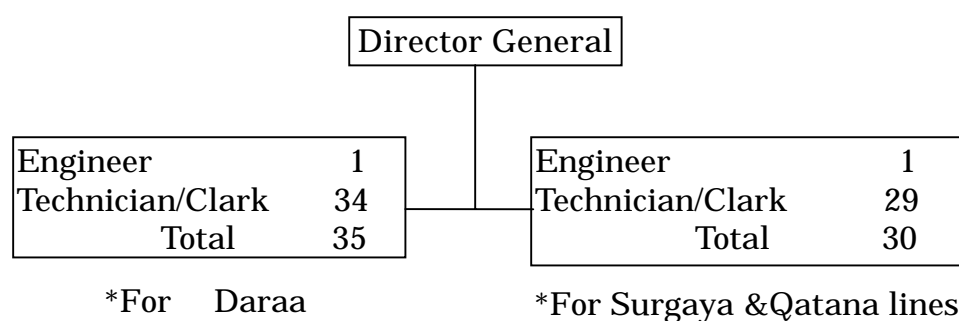
Some persons in charge of maintenance are appointed for each line section, but any maintenance work-system to plan and promote its maintenance work systematically is not established yet.

The following are the number of persons for the maintenance system of the respective lines.

* For Daraa line 35 persons in charge
 * For Surgaya and Qatana lines 30 persons in charge
 Total 65 persons

*Team system by section does not exist in the respective maintenance systems.

The organization is summarized as follow.



c) Track inspection

The round inspection frequency and inspection method for irregularities are as follows.

- Inspection by track bicycles or on foot to be made everyday
- Driver's daily report
- Track irregularities to be measured by eyes and simplified measurement devices

d) Devices for maintenance

Track and track facilities are chiefly maintained by manpower and however it is not clarified yet to utilize heavy equipment and machines or devices for the said maintenance.

e) Maintenance cost

An annual work plan and a budget plan for the maintenance are not cleared yet.

The track maintenance seems to repeatedly be conducted as a temporary and/or emergent work.

It is indispensable to contemplate promoting the maintenance of track facilities systematically.

(6) Issues from now onward

The track facilities of the GEHR 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 went 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 is 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 project section set by the GEHR, inter aria, to facilitate the betterment with emphasis on the track.

The following should be taken into account for the improvement of the track.

To scrutinize the present situation of the track in respective line sections

To select important sections for the improvement and give them their priorities by section

To formulate an improvement plan, personnel plan and budget plan

To materialize the respective plans pursuant to order of their respective priorities

The amelioration of the track is composed of the following items.

- To exchange the rails of 22 kg/m for much heavier rails.
- To exchange the existing rails for much longer rails
- To exchange the steel sleepers for concrete sleepers
- To replenish track ballast and/or replace the track bed ballast with new ballast
- To exchange the existing turnouts for the ones with an angle of smaller degrees

The following points should be taken into account on the measures to be investigated for the improvement of facilities and the prevention of accidents.

- To improve track formation on the respective embankment sections
- To provide cut sections with prevention nets and/or countermeasures against dropping stones and the like
- To prepare protective fences and/or boundary fences for preventing any ones from entering into the railway areas
- To prepare track sign posts
- To establish countermeasures of the prevention against traffic accidents at the level crossings and traffic rules for pedestrians and/or vehicles

4.4.2 Signal and Telecommunication Facilities

Two trains or less a day are now operated in almost all the lines.

The railway network in GEHR consists of five main lines and other short lines.

Diesel cars and locomotive passenger trains are operated in all lines ,while the freight trains are operated in some specific lines.

Locomotives, coaches, and diesel cars are aged.

They were manufactured in the former USSR, the former DDR, Hungary, and France.

The main lines were constructed about 100 years ago and all the railway facilities are aged too.

(1) Train Operating System

As mentioned above, since only two trains or less a day are operated in almost all the lines, block systems are, therefore, not introduced.

Almost all stations have more than one turnouts and points.

The switches are, however, locked in more than half stations.

Old magnetic telephones and the overhead bare wires have been used in the past, but they are not used at present because of becoming decrepit.

The subscriber telephones are, therefore, used for the train operation.

There is no wireless telephone system in the GEHR.

The iron sleepers are widely used, on condition that there is no track circuit.

The maximum train speed between stations is about 40km/h, but the speed of trains running within station area and across the level crossing is about 20 ~ 30km/h.

(2) Level Crossing

There are more than 200 railway level crossing in total, and they do not have any protection devices.

Among them only three level crossings are with guard, about five percent of level crossings without guard are supervised by dispatched guard from the center where fifty staffs are pooled, only when a train is running through.

The ninety-five percentages of railway accidents occur on the level crossings.

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

At present in the GEHR the new level crossing protection device is being developed for the road, which has a crossing just before the level crossing, in cooperation with the association of invention and it is under testing in near Qudam station.

The outline of the function of the device is as follows:

When a train approaches the spot within 200m from the level crossing, the loco-driver pushes a button of his transceiver. And the signals both on the railway side and crossover road are operated.

This system will be in general use after testing in following three stages.

The details of each stage are as follows.

[1st stage]

Two railway signals and two road signals of the above-mentioned system is now being tested.

[2nd stage]

Another two signals at the road crossing will be tested to be added to the two railway signals and two road signals.

[3rd stage]

The two automatic barriers are added to each right side of the railway level crossing.

(3) Training

For the technical skills of signaling and telecommunication engineers, “ On the Job Training (abr. OJT) ”is carried out by skilled staffs(e.g. chiefs of workshop) on man to man system.

(4) Maintenance

Signaling and telecommunication facilities are maintained by the Telecommunication Department in Telecommunication and Track Bureau.

Number of staffs belonging to the Signaling & Tele- communication Section of the Rail Bureau is 15 at present, and they are stationed at Qudam station.

(5) Summary of Signal and Telecommunication Facilities

The summary of electric facilities is shown in the Table 4.4.3 below.

Table 4.4.3 Signal and Telecommunication Facilities

Name of line	[km]	Signal	Number of level crossing with road	Switch	Signal, Telecom.& Power supply	Opening year
Al Hijaz ~ Surgaya	58	none	36	17 6(lockded)	none	1895 (by France)
Al Hijaz ~ Qatana	40	none	24	0 18(lockded)	none	1967 ~ 1973
Al Hijaz ~ Daraa	28	none	84	55 9(lockded)	none	1900 ~ 1908 (by Turkey)
Daraa ~ Bosra	#40	none	14	unknown	none	Unknown
Daraa ~ Al-Muzeireeb	*11	none	42	unknown	none	Unknown

(#) Exception of the section: Bosra ~ Amphitheater[2 km]

(*) Including Al-Magaarin to As-Shajara section (16.338km in total)

4.5 Operation, Management and Financial Standings

4.5.1 Financial Standings

(1) The Business Structure of GEHR

GEHR consists of two sections, Sargaya Line constructed by Syria and all the other lines coming from the old Hijaz Railway jointly invested and built by three countries, Syria, Jordan and Saudi Arabia mainly for transport of pilgrims.

Today both have been consolidated to one company 100% held by Syrian Government, but the financial statements have been made separately for each section.

Business of GEHR is divided into 5 categories including railway transport.

Real estate division 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 (Table 4.4.1).

GEHR is also manufacturing number plates of automobiles for Traffic Police Department by using the equipments in the factory for maintenance of rolling stock. The materials are supplied from the customer and GEHR receives only processing fee.

The sales of this division fluctuate sharply every four or five years because of the renewal cycle of the plates.

Other division is all kinds of miscellaneous revenue including interest on bank deposit.

In 1999 GEHR received proceeds from the sales of the stock of a real estate company in Lebanon sleeping for a long time and the revenue of other division increased.

Table 4.4.1 Breakdown of Revenue (GEHR)

(UNIT: THOUSAND SYRIAN POUNDS)

CODE	ITEM	1995	1996	1997	1998	1999
42	REVENUE INTERNAL WORKS SHARE	91 0.1%	23 0.0%	67 0.0%	198 0.1%	0 0.0%
43	NUMBER PLATES SHARE	7,562 9.4%	47,251 28.5%	163,891 54.3%	109,177 45.5%	15,053 9.7%
44	TRANSPORT REVENUE SHARE	1,856 2.3%	5,433 3.3%	7,742 2.6%	7,536 3.1%	10,423 6.7%
473	RENT SHARE	66,554 82.9%	103,318 62.4%	124,967 41.4%	114,130 47.5%	106,455 68.6%
472/5/6/7	OTHERS SHARE	4,182 5.2%	9,523 5.8%	5,155 1.7%	9,071 3.8%	23,246 15.0%
	REVENUE TOTAL SHARE	80,246 100%	165,547 100%	301,822 100%	240,112 100%	155,176 100%

(2) Transport Revenue

Under these circumstances, the transport revenue of GEHR was only about 3% of total 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.

In 1999 transport revenue occupied 6.7% of total revenue because of the fare hike for 6~7% in the previous year as well as production of number plates at the bottom.

In GEHR revenue of passenger fare is in most cases exceeds freight charge, but it is remarkable that the amount of miscellaneous revenue is very high, around 50% of total transport revenue (Table 4.4.2).

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.

Table 4.4.2 Transportation Volume & Revenue (GEHR)

ITEM	UNIT	1995	1996	1997	1998	1999
NUMBER OF PASSENGERS	PERSONS	62,930	78,922	85,333	99,709	94,189
NUMBER OF PASSENGERS	PERSON · KM	2,580,130	1,703,580	2,143,921	1,960,352	3,535,439
TRANSPORTED FREIGHT	TON	600	1,691	2,350	1,907	1,916
TRANSPORTED FREIGHT	TON · KM	84,600	238,431	331,350	268,887	270,156
TRANSPORT REVENUE						
PASSENGERS	'000 S.Pounds	823	1,093	2,384	2,177	2,373
INDEX	1995 = 100	100	133	290	265	288
SHARE	%	44.3%	20.1%	30.8%	28.9%	22.8%
FREIGHT	'000 S.Pounds	726	1,375	1,769	1,713	1,871
INDEX	1995 = 100	100	189	244	236	258
SHARE	%	39.1%	25.3%	22.8%	22.7%	18.0%
MISCELLANEOUS	'000 S.Pounds	307	2,965	3,589	3,645	6,179
INDEX	1995 = 100	100	966	1,169	1,187	2,013
SHARE	%	16.5%	54.6%	46.4%	48.4%	59.3%
TOTAL	'000 S.Pounds	1,856	5,433	7,742	7,535	10,423
INDEX	1995 = 100	100	293	417	406	562
SHARE	%	100%	100%	100%	100%	100%
NUMBER OF TOURIST TRIPS		6	33	33	49	42
INDEX	1995 = 100	100	550	550	817	700

(3) Profit and Loss Status

GEHR has allocated the revenue of each division to Sargaya Line and Other Lines and both sections have made profit since 1996. Profit and loss status of each division is not clear, but nowadays there is no doubt that GEHR's main line of business is real estate division. Hijaz "Railway" is only a title representing its origin and history.

To clarify the actual profit and loss situation of transport division, we divide total personnel cost of GEHR in 1999 (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.

$$59,448 \times 470 / (470 + 140) = 45,804 \text{ thousand Syrian Pounds}$$

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.

The Government has the right to appoint the Director General.

Every year its budget must be approved by Ministry of Finance, but so far GEHR has not been requested to amend its draft by MOF. Domestic passenger fare can be established by GEHR itself. If any remark is presented by Ministry of Transport, the plan needs to be reconsidered, but there has been no such a case in the past.

The present level of passenger fare is as low as only 40 Syrian Pounds for the whole Sargaya Line (57km). In recent years, GEHR has started to pay dividend to the shareholder (the Government) backed up by favorable financial results.

On the other hands necessary funds for its projects such as the purchase of rolling stock etc .are supplied by the Government. In this area GEHR and the Government are in very close relation.

(2) Organization

Organization of GEHR and the number of personnel belonging to each division from 1995 are shown in Table 4.4.3. Headquarters consist of seven divisions.

Railway division and non-railway division are not divided.

Three field organizations are basically railway divisions though they are also producing goods sold to outward by using the machinery and equipments in the railway factory.

There is no post controlling three railway divisions as a whole.

All divisions are under direct control of the Director General.

Number of employees of GEHR is increasing every year. Increase of personnel in three

field organizations is especially high, nearly 50 % up from 1995 to 1999.

During this period growth rate of transport volume was high, but it started from very low point and GEHR held a great heritage, a lot of railway workers.

It is doubtful whether new employment in proportion to the increase of transport volume was indispensable or not.

Table 4.4.3 Number of Employees (GEHR)

DIVISION	1995	1996	1997	1998	1999
Legal Administration Division	12	15	18	20	20
Secretariat of Director General	10	14	16	17	20
Planning Division	-	4	4	8	8
Real Estate Division	20	25	30	30	30
Financial Division	65	43	40	43	45
Accounting Division	-	10	10	11	12
Inspection Division	3	3	3	4	5
SUB-TOTAL	110	114	121	133	140
Rolling Stock & Traction Division	160	177	192	205	220
Transport Division	60	65	70	75	80
Buildings & Track Division	100	130	150	163	170
SUB-TOTAL	320	372	412	443	470
TOTAL	430	486	533	576	610

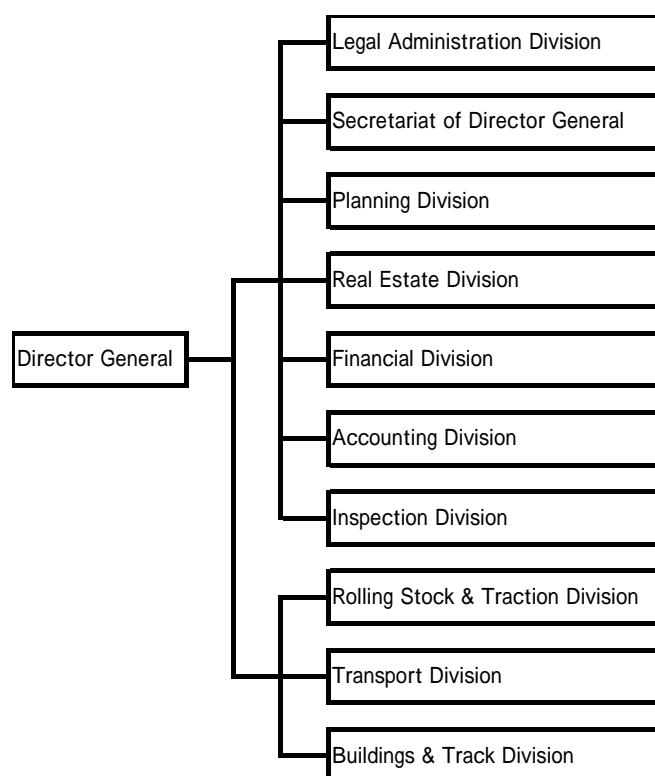


Fig. 4.4.1 Organization Chart of GEHR

(3) Trends towards Privatization

Although GEHR does not consider any reform of management such as separation of account between infrastructure and operation, division of railway activities, and privatization, but it plans private sector's participation in railway operation.

Operation contract of excursion trains by a travel agent is now under consideration as partial privatization trial. GEHR provides a travel agent with steam locomotives, coaches and necessary facilities at stations etc.

The agent adopts necessary personnel from the list presented by GEHR and the trains are put into operation under the responsibility of the agent.

It guarantees the minimum number of trains to be operated during one year.

If this plan realizes, it will be the first project of private sector's participation in Syrian railway.

**PART II THE REHABILITATION/MODERNIZATION
AND DEVELOPMENT PLAN**

Chapter 5

The Basic Policy of the Study

Chapter 5 The Basic Policy of the Study

5.1 Main Points of the Basic Policy of the Study

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

(1) Conformity with other development Plans

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

(2) Target years

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

(3) Realistic and Feasible Plan

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

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

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

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

(5) Enhance Investment Efficiency

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

(6) Ensure Easy Maintenance

Ensure easy maintenance in the future, by taking into consideration the technical skills and technical standards of GESR and GEHR.

(7) Attention to Environment Issues

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

(8) Improvement of Management

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

(9) Others

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

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

The siding construction projects will be treated in the same way as the urban transport projects because future railway traffic forecast can not be obtained due to absence of a definite production plan for factories.

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

5.2.1 General

Based on the results of site surveys and consultations with the Syrian side (refer to Appendix 5-1), the projects of GESR and GEHR to be covered by the master plan have been decided as shown in the following sections.

The projects of GESR are classified into two categories: (1) Rehabilitation and Modernization of Existing Facilities Projects and (2) New Line Construction Projects. Although there are some siding construction projects, they are not included in the cost / benefit analysis of the Master Plan as mentioned in the section 5. 1(9). The projects of GEHR are composed of mainly rehabilitation projects. Some urban transport projects envisaged by GESR are not included in the rehabilitation programs of Master Plan as mentioned in the section 5. 1 (9).

5.2.2 GESR

(1) Rehabilitation and Modernization of Existing Facilities Projects

Based on the results of consultations with the Syrian side, these projects are composed of the 13 projects shown in the table 5.2.1. Specifically, they are eight sectional projects for existing line improvement; three projects for workshop improvement, one project each for freight information system and rolling stock procurement.

Concerning these projects, staged development plans have been drawn up as shown in Table 5.2.1. This table was prepared based on the results of consultation with the Syrian side and with due consideration on priority of the projects, international traffic and efficiency of project implementation. In giving priorities to the projects, comprehensive evaluation has been made from various aspects, such as benefit/cost aspect, socio-economic factors, number of trains, railway facilities, and the ranks which the Syrian side is aiming at.

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

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

Legend :

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

(2) New Line Construction Projects

These projects are composed of the eight new line construction projects and rolling stock procurement project shown in the Table 5.2.2.

Concerning these projects, staged development plans have be drawn up as shown in Table 5.2.2, on the basis of the results of consultations with the Syrian side and with due consideration on priority, project implementation efficiency etc. In giving priorities to the projects, comprehensive evaluation has been made from various aspects, such as benefit/cost aspect, socio-economic factors, number of trains, railway network planning, and the ranks which the Syrian side is aiming at.

Table 5.2.2 Staged Development Plan (New Line Construction)

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

Legend :

■ Substantial Work

■ Auxiliary Work

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

(3) Siding Construction Projects

These projects are composed of the following six projects which the Ministry of Industry and GESR are planning.

Table 5.2.3 Siding Construction

No.	Project
1	Muslimia ~ Industrial Zone
2	Adra ~ Industrial Zone
3	Noamia ~ Industrial Zone
4	Jisr Elshogour for Suger Beat Factory
5	Tel Alo ~ Al Rumilan for Crude Oil & Natural Gas
6	Hassaka ~ Shddadah for Crude Oil & Natural Gas

However, as a result of consultations with the Syrian side, these projects will not be taken up in the cost/benefit analysis of the master plan, because production plans for factories and related railway traffic volume are not clear.

In the future, when the production plans for factories and related railway traffic volume become definite, a feasibility study is recommended to be carried out by GESR, and the execution of the siding construction projects should be planned based on the result of feasibility study.

5.2.3 GEHR

The project of GEHR are composed of the following five rehabilitation and new line construction projects as shown in Table 5.2.4. The order of priority of these projects have been decided on the basis of the results of consultations with the Syrian side. Damascus ~ Airport line construction and tramway projects will not be included in the rehabilitation programs of master plan but related non-quantitative discussion only will be provided as mentioned in the section 5.1 (9).

Table 5.2.4. GEHR Projects

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

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

The main roles of the current GEHR lines are expected to play a role in contributing to urban transport in Damascus City and transport of pilgrims and tourists. However, in the Study, urban transport projects are to be excluded. As such, the improvement plan of the existing lines of GEHR (No.1, 2 and 3 above) with the minimum investment will be planned on the basis of the present situation and also by placing great emphasis on safety in train operation. The construction of Kadam ~ Hidjaz station project should be studied together with GESR project.

The cost/benefit analysis of GEHR project No.1, 2, 3 above will not be carried out but their improvement plans are collectively described in Chapter 16 of this Report.