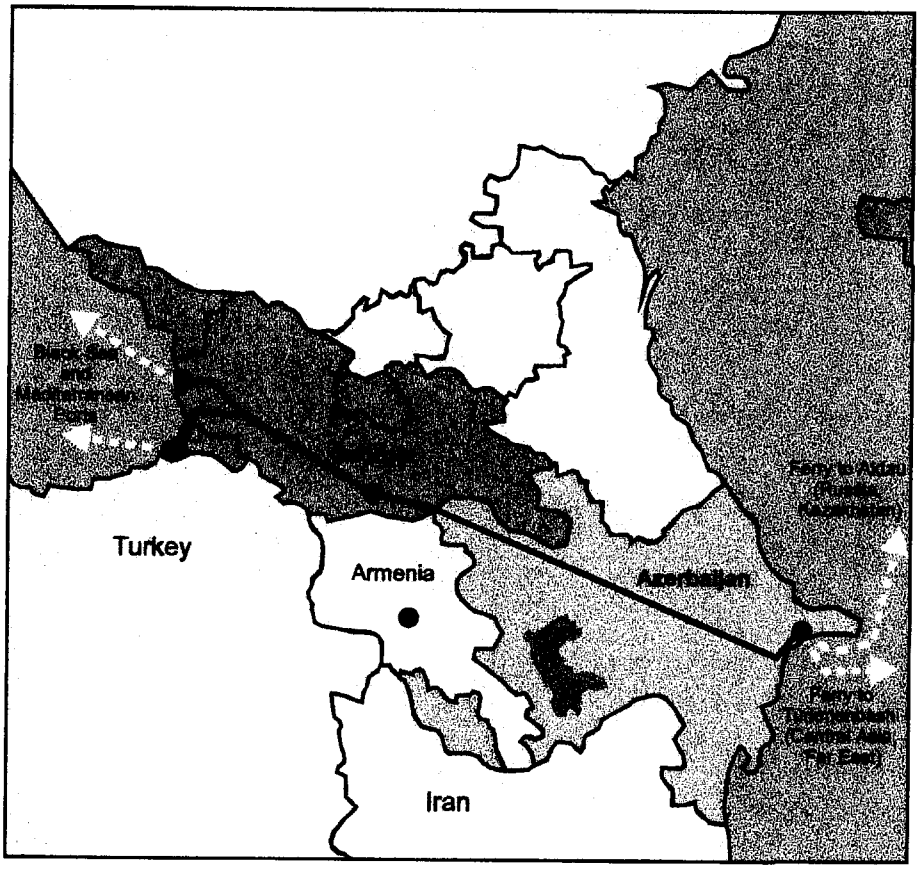
TRACECA

Infrastructure Maintenance 1
-
Railways
Pre-Investment study and Pilot train
Baku - Tbilisi - Batumi/Poti



Final Report

Module A

Volume I

October 1997

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Final Report Module A

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1 Executive Summary

1.1 General

The disintegration of the former Soviet Union, amongst others, led to significant structural and administrative changes for the railways of the Caucasus region. The Trans-Caucasian Railways (Georgia, Armenia) and the Azerbaijan Railways were one administration each in the network of the former Soviet Railways (SZD). After the Soviet Union was dissolved, national railways were established in all republics.

The following table shows some selected parameters for the railways of Azerbaijan (AGZD) and Georgia (GRZD) (as in 1995):

	Azerbaijan	Georgia
Size of network (km)	2,123	1,839
electrified (%)	60.0	100.0
double-track (%)	38.0	18.5
Network density (km/1000 km²)	24.7	26.4
Locomotives	226	230,5[1]
Freight wagons	29,118[2]	21,095[2]
Coaches	853	1,085
staff ('000 persons)	40.6	25.3
productivity ('000 tkm/employee)	97	60

[1]) 0.5 means part of a double-section locomotive

[2]) taken over from SZD, not completely available in part, as they are in other CIS states

Because of the economic situation, but also due to the political development in the region, there is a dramatic decline in the transport volume of the two railways. This quantitative drop was accompanied by a deterioration in quality of the transport services.

The comparison of the transport values of 1989 and 1995 in the tables and the graph to follow give an idea of how much transport volumes and transport performances were reduced in passenger transport and freight transport.:

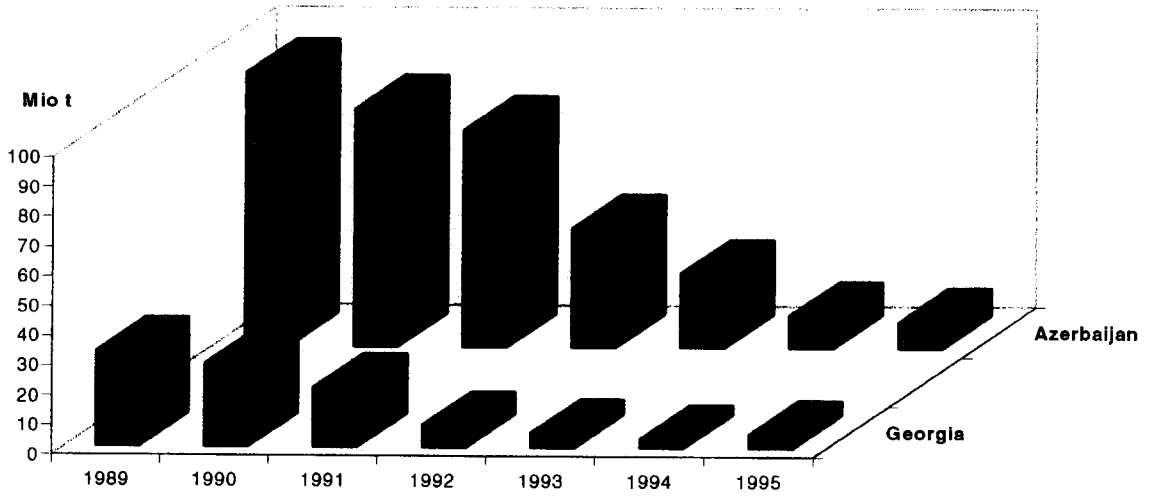
Passenger Transport

	Year	Azerbaijan	Georgia
passengers transported (1,000 pass.)	1989	19,600	17,000
	1995	10,600	3,676
transport performance 1,000,000 pkm	1989	2,042.9	2,135
	1995	1,111.9	371

Freight Transport

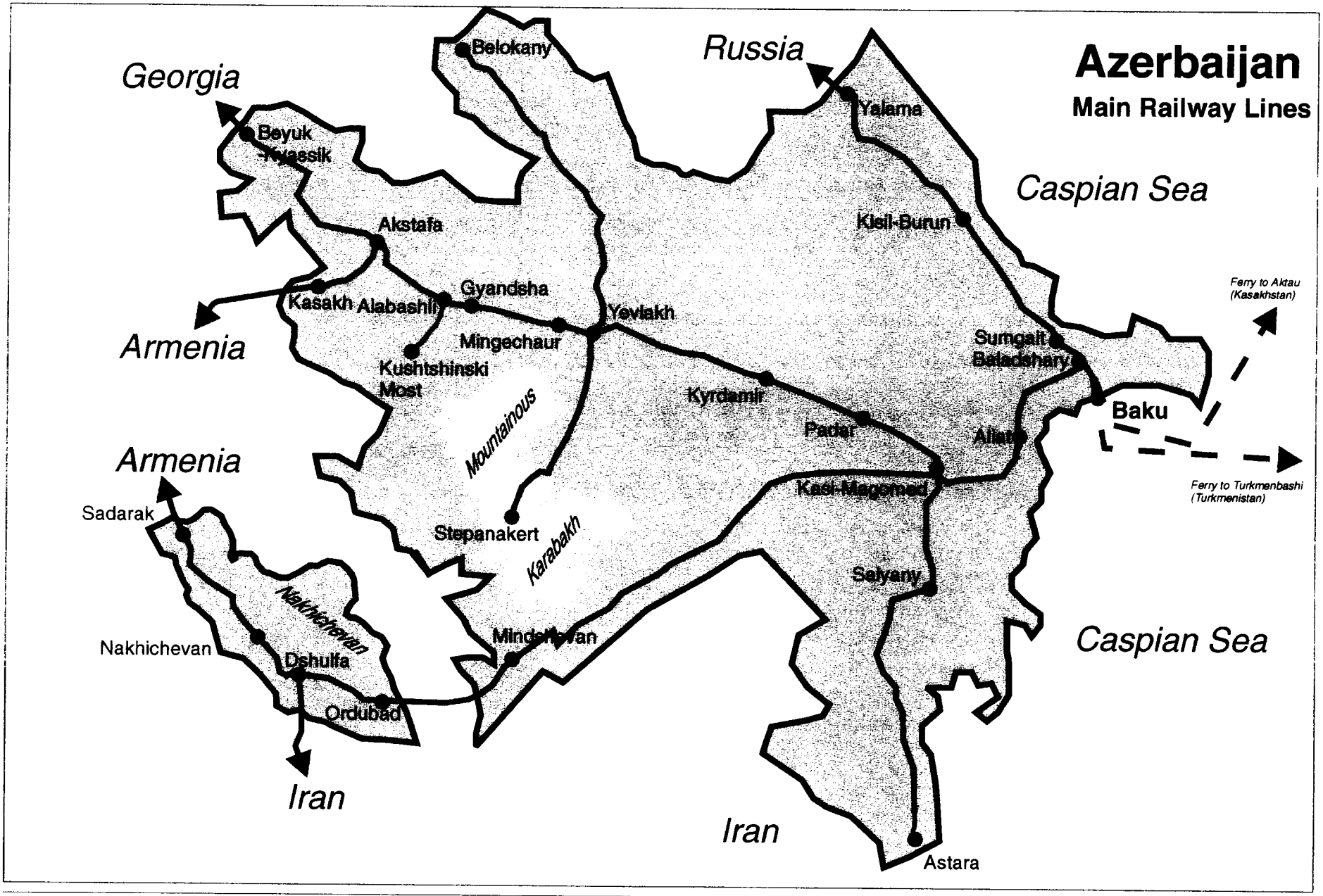
	Year	Azerbaijan	Georgia
transport volume	1989	91.4	36.2
1,000,000 tons	1995	9.1	4.7
transport performance	1989	41,895	12,591
1,000,000 tkm	1995	2,409	1,246

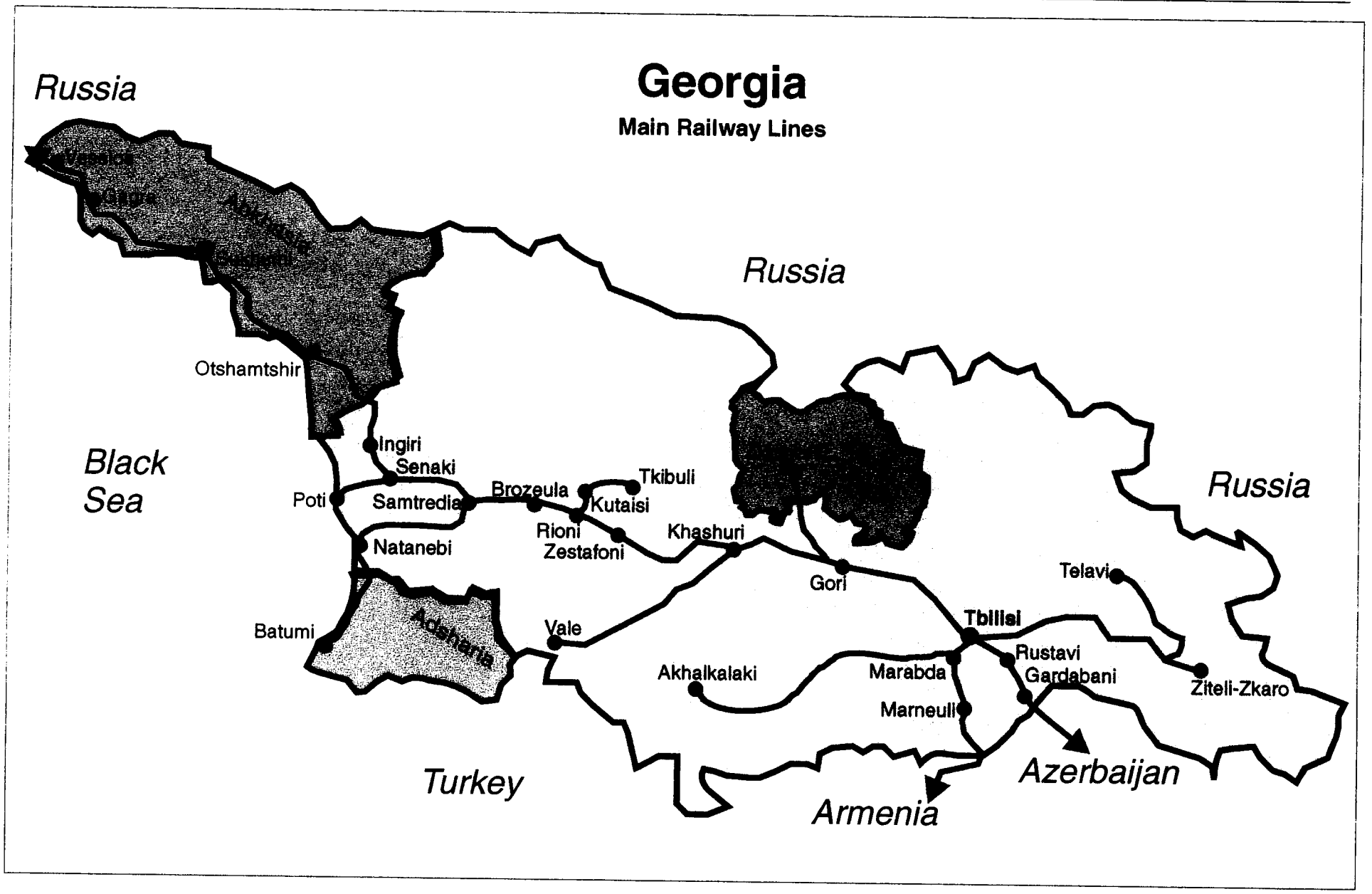
Freight transport volumes of the railways



The quoted decline in the transport volumes both in goods and in passenger transport, combined with the general economic difficulties in these countries has led to a significant reduction in the revenue of the railways. One of the consequences was that over the past few years next to no financial means were available for maintaining or extending the infrastructure or the rolling stock, which led to a dramatic deterioration of the technical condition in these areas. The situation in communication technology and information systems is especially critical.

Because of their geographic location, the two countries are important transit countries for international rail traffic. Unfortunately, the political development in the region has led to the situation that especially transit traffic, and thus the international significance of the Caucasian railways, has dwindled. The shutting down of such important railway corridors as Baku - Yalama - Russia, Baku - Nakhichevan - Dshulfa - Iran or Tbilisi - Sukhumi - Russia, Tbilisi - Armenia - Dshulfa - Iran and the Baku - Aktau railway ferry link has had especially negative effects. International rail traffic via the railways of these countries has stopped more or less completely. At present the most important railway line for domestic and international/transit traffic for both countries is the Caucasian main railway line Baku - Tbilisi - Poti/Batumi.


Azerbaijan
Main Railway Lines
Georgia
Russia
Armenia
Armenia
Iran
Iran
Caspian Sea
Caspian Sea
Belokany
Beyuk Yyassik
Akstafa
Kasakh
Alabashli
Gyandsha
Yevlakh
Mingechaur
Kushtshinski Most
Mountainous
Karabakh
Stepanakert
Sadarak
Nakhichevan
Nakhichevan
Dshulfa
Ordubad
Minderlevan
Yalama
Kisil-Burun
Ferry to Aktau (Kasakhstan)
Sumgait
Balackhary
Baku
Kyrdamir
Padar
Alat
Ferry to Turkmenbashi (Turkmenistan)
Kasi-Magomed
Salyany
Astara


Georgia
Main Railway Lines
Russia
Russia
Russia
Black Sea
Turkey
Armenia
Azerbaijan
Abkhazia
Adzharia
Otshamtshir
Ingiri
Senaki
Poti
Samtredia
Brozeula
Tkibuli
Kutaisi
Rioni
Zestafoni
Khashuri
Natanebi
Batumi
Vale
Gori
Telavi
Tbilisi
Rustavi
Gardabani
Ziteli-Zkaro
Akhalkalaki
Marabda
Marneuli

The given project deals with the situation of the two railway organisations along the transport corridor in the region from the Black Sea to the Caspian Sea and especially with the situation of that main railway line-

Since the overall work on the project was started in May 1996, all the data the consultants could use was from 1995 (in some cases even older) and partly from 1996. Also, the visual impressions of the experts during visits and excursions of railway stations, installations and plants reflect the situation from May 1996 up to the end of 1996.
In order to reach a complete picture the needed investigations were split into the institutional and organisational, the commercial and the different technical pre-feasibility's. Then the financial pre-feasibility was worked out followed by the further criteria and ranking, on the elaboration of Financing Memorandums for the rehabilitation measures identified.
This project report summary for Module A contains a short overview about the achieved results concerning the overall pre-feasibility as main part of the pre-investment study leading to and ending with further criteria and ranking.

1.2 Commercial pre-feasibility

Freight traffic forecast

Apart from the general problems in drawing up a forecast for traffic development under the current political and economic conditions in the region, there were additional difficulties due to existing problems in making available the necessary statistical reference data. Whereas relatively detailed internal statistical data on the development of traffic could be made available by the Azerbaijan Railways, Georgian Railways have not got available such detailed data. Unfortunately, there is scarcely reliable data on road transport in all countries.

Traditional mathematical and statistical methods of traffic forecasts, normally used under West European conditions, do not apply to the prognosis of traffic flows under the current situation in East European countries. These methods would lead to very imprecise results, under the conditions prevailing in the successor states to the Former Soviet Union (FSU), at the moment. The most important reasons, which make a different methodological approach necessary, are:

- The disintegration of the Soviet Union and the transition from the centrally planned economy to market economy structures have led to thoroughgoing structural changes in politics and the economy;

- The traditional economic, trade and clearing relations between the former Soviet republics have more or less all collapsed. The trade relations of the republics investigated are currently undergoing a completely new geographical and structural orientation;

- The former strong central influence on the role of the individual modes of transport led to a state approved modal split, which is now being influenced more and more by the conditions prevailing on the market;

- There is no detailed statistical data base on production, trade and traffic. Existing data is partly incomplete or the information is severely limited. Statistical time rows for the previous period of time are without informative value due to the considerable structural amendments or the changed statistical registration methods.

Due to the reasons mentioned, a methodology was applied in drawing up the traffic volume forecast, tailor-made for the conditions of the East European reform states.

On the basis of assessing factors of major influence and a special inter-linking of them annual growth rates were deducted for the development of the transport volume in the mentioned railway traffic for the period up to 2015, divided according to domestic traffic, export, import, transit and that in two scenarios. The statistical data for 1995 served as reference figures. Separate assumptions on the production and trade volume were made for individual types of goods, which are of particular importance for the total traffic volume. This applies especially to the oil processing sector, cotton, and container traffic.

The main findings and conclusions concerning the development of freight traffic up to the year 2015 are:

Azerbaijan

Transport volume of the Azerbaijan Railways up to the year 2015

	1995	2000		2010		2015	
		opt.	pess.	opt.	pess.	opt.	pess.
transport volume ('000 t)	9,073	20,102	12,992	29,690	20,519	34,825	23,685
transport performance ('000 000 tkm)	2,409	8,805	5,469	13,004	8,638	15,253	9,971

Georgia

Transport volume of the Georgian Railways up to the year 2015

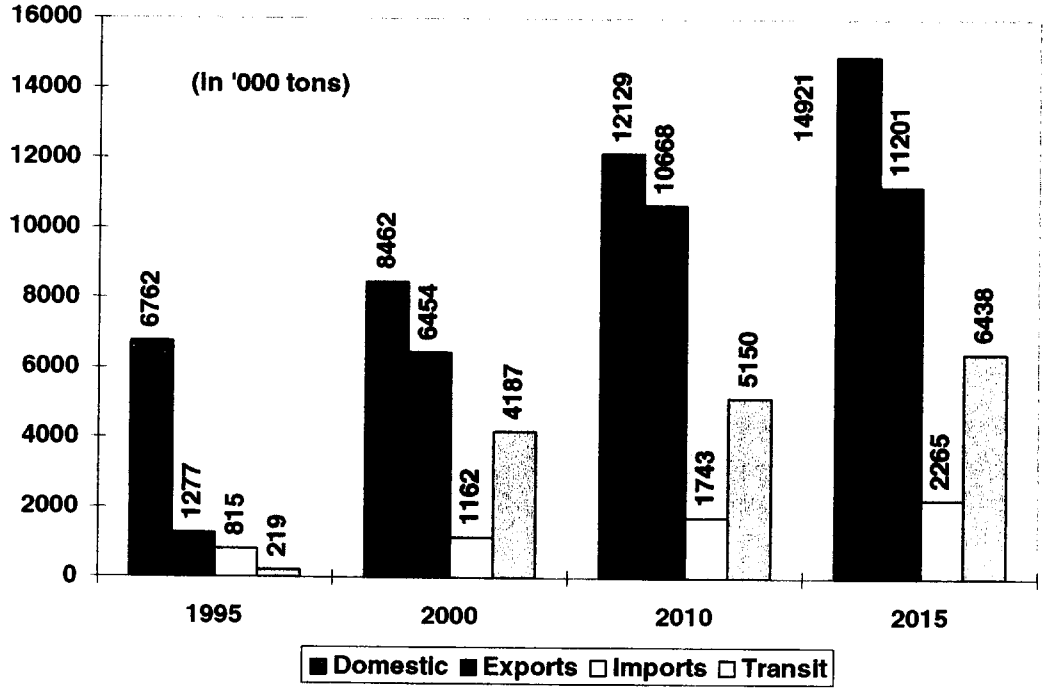
	1995	2000		2010		2015	
		opt.	pess.	opt.	pess.	opt.	pess.
transport volume ('000 t)	4,700	9,525	4,477	15,268	7,611	17,470	9,135
transport performance ('000 000 tkm)	1,246	3,238	1,522	5,191	2,588	5,940	3,106

The forwarding of the petrochemical products produced in Azerbaijan will maintain a dominating position in the rail freight traffic of the country. Their share in the total amount of goods transported was 70.7 per cent in 1995. It will have reached 59.1 per cent (optimistic scenarios) by the year 2000, in 2010 it will be 62.7 per cent and in 2015 the share will stand at 61.5 per cent. Parallel, the share of transit transports will rise considerably during the period under investigation. Whereas the share of transit transports was still 2.4 per cent in 1995, it will have reached 20.8 per cent (in the optimistic scenario) already in the year 2000. In the following years it will remain at about that level.

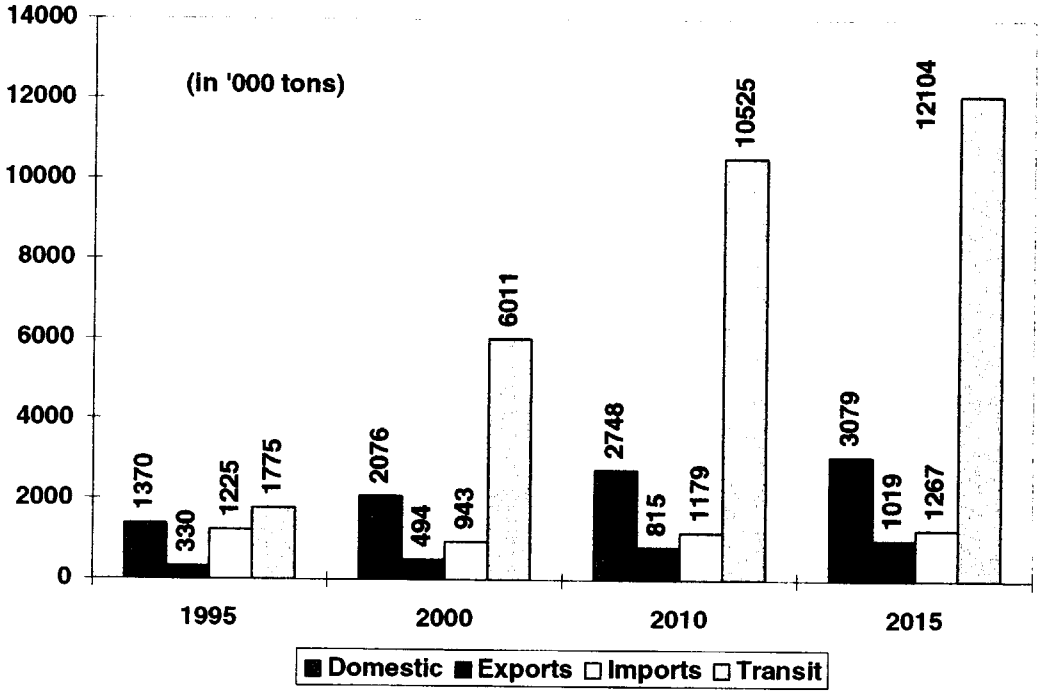
Transit traffic will gain a dominating role in the rail freight traffic of Georgia. Already in 1995, the share of transits in the total amount forwarded was high at 37.8 per cent, as compared to Azerbaijan. This share will already be 63.1 per cent (optimistic scenario) in the year 2000, and after that it will raise to about 70 per cent by the year 2015.

There will only be insignificant changes, as compared to the current situation, in the goods structure of rail traffic of the two countries.
The dominant importance of transit transports for Azerbaijan and Georgia can also be seen in the following figures, showing the development of the individual components of rail freight traffic:

Development of Azerbaijan rail freight traffic up to 2015 (optimistic scenario)



Development of Georgian rail freight traffic up to 2015 (optimistic scenario)



Passenger traffic forecast

The forecast of the volume in passenger traffic was based on the following general political and economic development in the region:

The internal political situation in the countries will remain more or less stable over the next few years and will have a relatively insignificant influence on the number of passengers. The political situation in the region as a whole is of much greater importance, as this is what the development of international rail traffic but also national domestic long-haul traffic depend on. As regards the re-introduction of rail passenger traffic on the main lines, the two scenarios are based on the following development:

Relation	*optimistic*	*pessimistic*
re-introduction of passenger transport on the Tbilisi - Yerevan line	1998	2000
regular traffic Baku - Yalama - (Makhachkala/ Russia)	1997/98	2000
re-introduction of rail traffic via Nakhichevan	2000	2005
unimpeded rail traffic through Abkhasia	2000	2003

Azerbaijan

In Azerbaijan the modal split will continue to shift in favour of transport by road. The total traffic volume will continue to decrease until 1997 and only slightly rise as of 1998. In railway traffic, a growth in passengers transported may be reckoned with as of 1998 at the earliest (optimistic scenario), but an increase is more likely only after the year 2000.

A growth in international traffic may be expected as of 1989 (optimistic scenario) or 2000 (pessimistic) with the normalisation of traffic on the Baku - Yalama - Russia line. A further increase will take place as of 2000 (optimistic) or 2005 (pessimistic) with the re-instatement of services to and through Nakhichevan. The start of operations on this line will also lead to a significant increase in domestic traffic.

As of 1997 the following average transport distances are expected:

Regional traffic	25 km
Domestic traffic	250 km
International traffic	295 km

This results in the passenger traffic volumes for the Azerbaijan State Railways as shown in the table below.

Rail passenger traffic in Azerbaijan up to the year 2015

(,000)

	1997	2000	2005	2010	2015
Passengers ('000)					
optimistic	4,333	5,205	7,316	9,396	10,717
pessimistic	3,644	3,292	3,928	4,457	4,709
Pkm ('000,000)					
optimistic	426.8	563.3	889.9	1,153.1	1,330.0
pessimistic	392.9	380.6	518.9	590.9	628.6

The number of people transported in the optimistic version will rise to 119 per cent of the 1995 level by the year 2015, and in the pessimistic scenario the level is a mere 52 per cent of the 1995 figure. These large differences between the two scenarios result above all from the assumed repeated serious drop in the period of 1997/98 in the pessimistic scenario and the much later opening of important lines in long-haul traffic.

Georgia

In Georgia, the volume of the overall passenger traffic has risen since 1995 once more. However, the railways cannot profit from this yet, even in 1997. Thus, in Georgia, too, there will be a further increase in the proportion of road transport.

Impulses for an increase in the volume of Georgia's railway passenger transport will emanate from the re-instatement of services to and through Abkhasia. This applies both to the domestic long-haul as well as international traffic. A further increase of traffic will be linked with the start of traffic to Armenia.

The following average transport distances are assumed for the Georgian Railways as of 1997:

Regional traffic	45 km
Domestic traffic	185 km
International traffic*	75 / 210 km

* 210 km as of 2000/2003 (optimistic/pessimistic) with re-instatement of traffic through Abkhasia

As a result, passenger volume and passenger transport performance of the Georgian Railways will develop as follows until 2015:

Rail passenger traffic in Georgia up to the year 2015

(,000)

	1997	2000	2005	2010	2015
Passengers ('000)					
optimistic	3,218	3,632	4,417	5,700	6,920
pessimistic	3,094	2,907	3,595	4,260	4,773
Pkm ('000,000)					
optimistic	348.4	412.4	516.5	715.6	897.3
pessimistic	337.7	320.5	449.1	550.1	620.2

In the optimistic scenario, the number of people transported will rise to 188 per cent of the 1995 level by the year 2015, and only to 130 per cent in the pessimistic version. These relatively high growth rates, compared with the other two countries, result, above all, from the comparatively low starting level in 1995, only 33 per cent of the 1991 level (Azerbaijan stood at 57 per cent and Armenia at 66 per cent).

In Georgia, the share of regional passenger transport will drop from 82 per cent in 1995 to 41 per cent in 2015 (optimistic scenario).

Financial forecast

The assessment of the financial situation of the two State Railways served on the one hand to derive decision-making aids as to the financing of a pilot train for the fast and secure transport of high quality goods on the Baku - Poti/Batumi relation, and on the other hand to design further measures geared towards the re-instatement of a safe and reliable train operation along this line.

The investigations comprised the following complexes:

- Development stage and expressiveness of the accounting system;
- Financial situation of the railways in the reference year 1995 on the basis of a specified profit and loss account with integrated cash-flow;
- Analysis of expenditures and revenues;
- Normalisation of the cost basis;
- Forecast of the railways' financial situation up to the year 2015 in variants.

The main conclusions from the assessment of the profit and loss account are:

1. The receivables from debtors of the railways, in connection with the political situation and together with the lacking revenue due to a decline in the transport performance and the collapse of the whole currency system have led to a complicated financial situation, which is affecting the whole operational process. The physical condition of the infrastructure is deteriorating permanently and the structure of the rolling stock is increasingly ageing. This situation can only be improved through a targeted investment policy to modernise the infrastructure and

the rolling stock step by step. This, however, calls for loans, which can only be made available by foreign banks.

2. To secure the liquidity of the railways the introduction of a banking system seems to be useful.

3. In order to secure payment of the transport service by transport customer, it is recommended to implement the system of advance freight payment more consistently. Simultaneously, the own responsibility of the railways in the field of business administration has to be increased by implementing the principle, "Those who order transport services, shall also pay for them"

4. The accounting system of the railways has to be developed further with regard to a higher degree of flexibility and dynamics. This further development should include setting up a functioning system of controlling, step-by-step as an instrument for modern cost management.

5. Cost-unit accounting is to be regarded as an important component of cost accounting. It is recommended to use this as the basis for a dynamic price calculation for fixing the tariffs.

The result of this work was completed by statements on the credit worthiness, the credit time, and the repayment arrangements.

Within the scope of the analysis results recommendations on how to improve the organisation of the accounting system and the financial situation of the railways:

Improvement of accounting system

The accounting system has to be modernised in a way that

- costs, revenues, and services are divided up according to 'planning' and 'post-accounting';
- costs, revenues, and services are divided up according to 'goods traffic', 'passenger traffic', 'workshops' and 'infrastructure';
- costs are compiled where they accrue (formation of cost centres like, e.g., passenger stations, goods stations and marshalling yards, container terminals; transport performance in passenger traffic; transport performance in goods traffic; lines, and others); the percentage of directly allocable costs has to be raised here.
- allocation of costs is done to so-called cost units. Cost units are, for instance, the following:
  * gross ton-kilometre
  * net ton-kilometre (goods traffic)
  * person-kilometre
  * train-kilometre
  * tractive unit service hour
  * train hour
  * train attendant hour

* tractive unit kilometre.

This allocation of cost to performance ratios also allows a more objective estimate of the investments to be needed or of any reduction of fixed assets, respectively (e.g. closing of lines, stations, or parts of the system).

- planning and results are compared monthly and that any deviations showing are analysed.

Furthermore, with a view to cost- and market-oriented pricing as an important contribution to an effective tariffing system, a modern price calculation method must be developed and introduced that can meet the conditions of changed market situations.

For introducing these tasks, the organisation of the accounting system has to be complemented by establishing a controlling system.

Improvement of the financial situation

1. Assuming that the railways are to be made self-sufficient enterprises, the average rates of revenue have to be raised to a normal level, which will also serve to pay the current costs of the investment programme to become necessary for the restoration and modernisation of railway operation.

   The specific revenues in goods traffic will be raised up to 2015

   - to 5.50 US-cents per tkm in the optimistic version, and
   - to 4.50 US-cents per tkm in the pessimistic version.

   50 per cent of this rise of the specific revenue rate can be reached by increases in freight rates, especially for higher tariffed goods, and another 50 per cent by raising the performance percentage of higher tariffed goods in the overall performance.

   The specific revenues in passenger traffic will be raised

   - to 10 US-cents per tkm in the optimistic version, and
   - to 5 US-cents per tkm in the pessimistic version.

   50 per cent of this rise could be reached, for instance, by an increase in passenger fares, and another 50 per cent by subsidies from the state.

   If the revenue rate would not increase, this would result in the pessimistic version for 2015 in a loss in passenger traffic of US-$ 21 ... 24 million.

2. A significant reduction of staff and staff costs is needed. Examples for rationalisation could be:

   - concentration of staff on the core business;
   - giving up system parts that do not directly contribute to the transport services on the main lines;
   - rationalisation in the field of workshops, maintenance and repair;

- reduction of operational performances in passenger and goods traffic by increased utilisation of transport capacities.

3. Reduction of costs accruing from the investment programme.
These costs, which mainly comprise costs for repairs and the depreciations, represent a considerable burden, which shows in the two versions. This burden becomes particularly evident for the 1997 to 2000 period (and in future, up to about 2005), in which the investment rates are especially high. To improve the financial situation, in a first version the investment programme would have to be 'unburdened'. This could be done, for instance, by shifting the priorities and thus deferring the investment amount to the respective following years.

Shifting of priorities would be imaginable, e.g., for rolling stock, the largest bloc of costs. For this purpose, repairs of locomotives and cars could be reduced, as could be the depreciations. Further possibilities would be:

- increase of the useful life of rolling stock and railway facilities;
- widening of repair cycles in terms of time;
- hiring (instead of purchasing) of rolling stock.

If, for instance, the cumulative investment amount for the 1997 to 2005 period could be reduced by 200 million US-$ (new ranking of priorities) and these investments could be made after the year 2005, this would result in an annual reduction of about 4 million US-$, which for both versions would mean a considerable improvement of the financial situation. Such a reduction could be achieved by

- concentrating the investments in the public transport way on those main lines only on which during the above mentioned period the transport performances as forecast will be produced;
- concentrating the investments in rolling stock only on those cars and locomotives which in the above period will be required for producing, under rationalised operational conditions, the transport performances as forecast.

1.3 Technical pre-feasibility

1.3.1 Azerbaijan State Railway

The technical pre-feasibility includes the aspects of track and buildings, rolling stock and of signalling and telecommunication.

The track and construction work of AGZD

The investigated line from Caspian Sea to the border point Georgia is marked by a high backlog of both the regularly track maintenance and the systematically annual track renewal.

The main evident defects concern the following basic principles

- poor condition on track subgrade, irregular profile and slope, insufficient ground base and draining capacity adapted to the existing subsoil quality
- low quality of ballast, due to the lack of side paths the sleeper ends are not supported by ballast and led to defective rail fastenings and damages on wooden and concrete sleepers
- tracks laid in cutting areas are not properly drained
- the contact wheel/rail has to be regular and continuous to avoid or to reduce dynamic corrosions.
-

The main improvements to the above mentioned defects are as follows:

1. The construction of the track foundation has to be carried out carefully taking into consideration the slope and side paths imposed by a cross-section type.
2. New prestressed concrete sleepers including new rail fastening elements.
3. Washed broken stones as ballast with high resistance and taking into consideration the prescribed grain size.
4. To introduce the technology of continuous long welded rails in track lines as well as in switches sections. Knowledge of aluminothermic rail welding has to be acquired.
5. Scheduled full maintenance in both track and constructions.

In order to rehabilitate the track line Baku - border point to Georgia there is a need for track and switch renewals and an annual renewal program until 2005, procurement of new equipment for districts, for the permanent way workshop, quarry, bridge renewals, major repairs and for training. The costs for this variety are estimated at 149.3 million US$ until 2010.

The rolling stock of AGZD

The problems with the rolling stock are focused mainly on the old age of locomotives and wagons accompanied by the lack of spares and equipment in the respective depots where regularly maintenance has to be ensured.
The situation concerning the locomotives age can be underlined by the fact that 80% of electric line-locomotives of the VL-8 type are older than 30 years. Consequently, a proposal was worked out for a scrapping and replacing programme (92 + 91 locomotives).

Due to the non-availability of a locomotive repair shop, the heavy regularly maintenance steps (TR-3, KR-1 and KR-2) can only be done abroad.

The non use of 65% of the wagon stock is caused by the low freight traffic volume. As a result, this non-operating stock is in a bad technical condition.

The pressing question concerning the wagon stock is the increasing demand for tanks to cover the growing transport volume of oil and oil products in the near future. It was estimated that there will be an additional requirement of 1,000 tanks to be rented or procured in 1997 or 1998. This problem can be solved by outsourcing the tank stock. But this question is more a legal/commercial one than a technical one.

For ensuring the regularly rolling stock maintenance in locomotive and wagon depots, there is a need to procure spares and several equipment.
The overall costs are estimated at 32.5 million US$ until 2000 and additionally at 368.2 million US$ until 2015.

The signalling and telecommunication systems of AGZD
The technical and operational conditions of the signalling plants of the station and section are satisfactory. The increasing age of the technique used will result in a decline in the technical conditions and an increasing number of breakdowns at the plants.
Due to the increasing transport volume, the reliability and operability of signalling have to be improved. The renewal of signalling is required in the short and medium term. 8 stations have to be completely replaced by new installations within the next 5 - 10 years. Furthermore, it is necessary for the increase of the passage on the section Baku - Beyuk-Kyassik to replace signal boxes which have hand-operated switches with new panel operated signal boxes on 6 stations. The complete financial need for renewing and maintaining signalling systems will amount to 155.3 million US$ for the period from 1997 to 2015.
The main problems concerning the telecommunication systems are the unreliable connections. This fact has considerable influence on railway traffic, too.
The sleeves needed for the connection of the lines have been used since 1983 and have partly become porous.
The improvement in the condition of the telecommunication installations in a short term should be the aim of the measures needed. It is also necessary to put into use new modern installations to meet the requirements of the increased transport volume. The complete financial need for renewing and maintaining telecommunication plants will amount to 38.0 million US$ during the period from 1997 to 2015.

1.3.2 Georgian Railway

The technical pre-feasibility includes the aspects of track, buildings, rolling stock and of signalling and telecommunication.

The track and construction work of GRZD
The investigated line from the Black Sea to the border point to Azerbaijan is marked by a high backlog of both full scheduled track maintenance and a systematically annual track renewal.

The main evident defects concern the following basic principles as:
- poor condition on track subgrade, irregular profile and slope, insufficient ground base and draining capacity adapted to the existing subsoil quality
- low stability of the ballast bed due to the lack of side paths with the consequence that the sleeper ends are not supported by ballast and led to defective rail fastenings and damages on wooden and concrete sleepers.
- tracks laid in cutting areas are not properly drained.
- the contact wheel/rail has to be regular and continuous to avoid or to reduce dynamic corrosions.

The main improvements to the above mentioned defects are as follows:

1. The construction of the track foundation has to be carried out carefully taking into consideration the slope and side paths imposed by a cross-section type.
2. New prestressed concrete sleepers including new rail fastening elements.
3. Washed broken stones as ballast with high resistance and taking into consideration the prescribed grain size.
4. To introduce the technology of continuous long welded rails in track lines as well as in switch sections. Knowledge of aluminothermic rail welding has to be acquired.
5. Scheduled full maintenance in both track and constructions

In order to rehabilitate the track line Baku - border point to Georgia there is a need for track and switch renewals and an annual renewal program until 2005, the procurement of new equipment for districts, for the permanent-way workshop, quarry, bridge renewals and for major repairs and training.
The costs for this variety are estimated at 79.9 million US$ until 2000 and with additional 115.5 million US$ until 2005.

The rolling stock of GRZD

The problems of the rolling stock are focused mainly on the old age of locomotives and wagons accompanied by the lack of spares and equipment in the respective depots where regularly maintenance has to be ensured.
The situation concerning the locomotives age can be underlined by the fact that 37% the electric line-locomotives of the VL-8 type are older than 30 years. Consequently, a proposal was worked out for a scrapping and replacing programme (32 + 53 locomotives).
The non-use of 78% of the wagon stock is caused by the low freight traffic volume. As a result, this non-operating stock is in a bad technical condition.

The wagon stock of GRZD is able to cover the future growing transport volume.
To cover the annual demand for heavy locomotive maintenance steps (KR-1 and KR-2) GRZD should co-operate with the Tbilisi Electro-locomotive Construction Factory.
The essential key project "Locomotive repair" under the terms of rolling stock for the "Trans-Caucasian Railways TRACECA project" means the establishment of a repair division at the **Tbilisi- Electro-Locomotive-Construction-Factory** (TECF).
The establishment of a repair division includes a wheelset repair shop, a traction motor shop and a shop for electric components. For ensuring the maintenance of the regularly rolling stock in locomotive and wagon depots there is a need to procure spares and several equipment.
The overall costs for rolling stock are estimated at 22.0 million US$ until 2000 and at additional 64.2 million US$ until 2010.

The signalling and telecommunication systems of GRZD

The technical and operational conditions of the signalling systems of the railway station and line equipment are satisfactory. The signalling equipment on the Samtredia - Poti and Samtredia - Batumi sections is no longer operative. Point mechanisms and choke transformers are to be regarded as priority concerning the equipment used. An emergency unit is available on the Gardabani - Zestafoni section to ensure a

troublefree power supply to the signalling equipment. Yet, a problem is the unreliable power supply.
The complete financial need for renewing and maintaining signalling systems will amount to 99.1 million US$ during the period from 1997 to 2010.

Concerning the telecommunication systems, the unstable connections of the telephone network have a top priority. This fact has also a remarkable influence on the train traffic. The whole telecommunication line of the Tbilisi-Batumi/Poti line was cabled. The cables required for the connection were dismounted on various sections due to vandalism. This condition had a remarkable influence on the working condition of the telecommunication facilities.
The improvement in the condition of the telecommunication installations in the short term should be the aim of the measures. It is also necessary to put into use new modern installations to meet the requirements of the increased transport volume.
The complete financial need for renewing and maintaining telecommunication plants will amount to 28.3 million US$ for the period from 1997 to 2010.

1.4 Financial pre-feasibility

The different economic results depending on the different possible traffic levels, namely the optimistic and the pessimistic forecast within the period from 1998 up to 2015, have been calculated. Resulting from this there are two alternatives for investments for the rolling stock to be operated and maintained as well as for different developments of operational costs. In case of a better economic development of the region the optimistic traffic forecast requires the following expenditures for both railways, the AGZD and the GRZD, over the period up to 2015 in order to bring the line up to the required standard and to maintain it at the functioning level attained:

Investments	**US$ 1,152 million**
Maintenance expenses	**US$ 1,361 million**
Total	**US$ 2,513 million**

In the case of a worse economic development of the region the pessimistic traffic forecast requires lower outlays for rolling stock and following expenditures will be required:

Investments	**US$ 800 million**
Maintenance expenses	**US$ 1,295 million**
Total	**US$ 2,095 million**

The railways will need considerable support in financing this amount of capital and operational expenses, which must necessarily come mainly from international funding. It is unlikely that any great amounts can be obtained on the open market without the support of the governments involved and other international agencies.
In addition to the amounts above, **Depreciation charges** amounting to **US$ 550 million** will need to be charged against revenues over the period mentioned in order to provide for the replacement of the assets involved.

The above costs for the individual railways are broken down as follows:

Required investments for construction and equipment - Azerbaijan

Year figures in million US $	2000	2005	2010	2015	Total
Bridges	4.9	5.3	0.9	-	11.1
Permanent Way	43.2	46.4	8.0	-	97.6
Permanent Way Maintenance	21.2	19.4	-	-	40.6
Rolling Stock	10.0	2.9	85.0	283.2	381.1
Workshops	10.3	9.3	-	-	19.6
Signalling	13.2	72.9	36.0	33.2	155.3
Telecommunications	13.2	18.2	6.6	-	38.0
Total	116.0	174.4	136.5	316.4	743.3

Tab. 4.2-3: Required investments for construction and equipment - Georgia

Year figures in million US $	2000	2005	2010	2015	Total
Bridges	9.1	3.0	-	-	12.1
Permanent Way	54.0	98.8	-	-	152.8
Permanent Way Maintenance	16.8	13.7	-	-	30.5
Rolling Stock	4.9	4.5	40.9	-	50.3
Workshops	17.1	10.8	8.0	-	35.9
Signalling	19.0	59.4	20.7	-	99.1
Telecommunications	7.4	14.3	6.6	-	28.3
Total	128.3	204.5	76.2	-	409.0

In estimating these requirements it has been assumed that the necessary measures can commence in 1998 and that the most urgent works will be undertaken in the three years up to and including the year 2000.

As an option the investments in rolling stock and workshops can be reduced by US$ 307.5 million in Azerbaijan and US$ 44.9 million in Georgia by delaying purchases to a later date, beyond the period of this study.

From enquiries made in the countries involved, it would appear that no local funding is available. It is also unlikely that at this stage private funds would be available for the major part of the investments required.

It seems, therefore, that at least in the early stages of the project, non-government funding will have to come from international organisations at very favourable rates. In order to support the railways in finding the investment identified and required, special "memorandum of financing" were developed for both the AGZD and GRZD.

Summarising the main findings and conclusions of the investigations performed, it can be stated, that the measures to rehabilitate the systems require enormous financial investments, which must be repaid out of future income or outside funding. It is important therefore that the investments undertaken be sustainable. For this to happen it is essential that the necessary maintenance programmes be followed and the required reserves for replacement of assets be charged against future income. In recent years the railways have been drawing on their substance to assure continuance of operations, resulting in serious shortcomings in the maintenance of their assets, cannibalisation and depletion of capital. For the recommended measures to be effective it is necessary that these practices be replaced by strict adherence to effective measures aimed at the upkeep of the assets.

Reorganisation of the railways into newly formed profit centres would provide more financial transparency in the operations. These sectors could include passenger services and the various services offered in the freight sector, such as transit freight, containers, petroleum products etc. Budgets should be drawn up along these lines and the corresponding costs recorded in cost centres within the individual sectors. The results of these sectors would provide the necessary data to determine which services are profitable and those operating at a loss or barely covering their costs.

In the case of the passenger services for example the data provided would form a basis for negotiations at a government level concerning the subsidisation of non-profitable services.

It is therefore recommended that attention be given to these considerations in any negotiations regarding funding of the recommended measures.

Final Report Module A

Chapter 2 Institutional, Organisational and Commercial Pre-feasibility

Final Report Module A

Chapter 2 Institutional, organisational and commercial pre-feasibility

2.1 Institutional and organisational pre-feasibility

2.1 Institutional and organisational pre-feasibility

The disintegration of the former Soviet Union has led to considerable structural and administrative changes in the railways of the Caucasian region. In the past, the Trans-Caucasian Railway (Georgia and Armenia) as well as the Azerbaijan Railway were administrations in the network of Soviet Railways (SZD). Following the dissolution of the Soviet Union, national railways were set up in all three republics.

The newly established railway administrations are not only up against the difficulties resulting from the general economic and political situation. Both the Georgian as well as the Azerbaijan railways are confronted with a number of specific problems, which have their root causes in the historical development as well as in the administrative and organisational structures of the former SZD. Some of these problems are, for example:

In the past many key positions were held by Russian specialists in the railway administrations, which the national successors do not have available any longer.

Universities and colleges in the area of railways were more or less exclusively to be found in Russia or the Ukraine respectively, thus the higher education facilities in Georgia and Azerbaijan being limited at the moment.

Repair shops for cars and engines are also mostly located on the territories of Russia or the Ukraine, and the repair of rolling stock is only possible to a very limited extent in the Caucasian republics at the moment;

Freight wagons, which had been allocated to the railways of Georgia and Azerbaijan as a consequence of dissolving SZD, as well as engines in their stock usually were in a desolate technical condition.

During the Inception phase consent with the Final recipients has been reached, that problems concerning the structure, organisation and management of the railways will be further analysed and deepened within the current project only to such an extent as it is necessary for the realisation of the different work streams within the project. That's why there is not given a separate detailed description of the results within this chapter of the report. The present situation, existing problems and bottlenecks as well as resulting recommendations regarding the organisational and institutional pre-conditions are elaborated within the respective chapters of this report.

Some main problems in the field of organisation may be summarised as follows:

The railways are still working in accordance with structures, regulations, and working methods dating from the times of the former Soviet Union.

At present there exist programs for changing the structure of the railways. However, works as yet are not progressed far enough for concrete development objectives or results to be available.

The dismissal of personnel up to now, out of social reasons, has not been in correspondence with the loss in transport performance.

The management qualities of the managerial staff at first dropped considerably, when the Russian employees that had worked in top positions left the railways. Meanwhile a younger, more motivated middle management with growing interest and qualifications is establishing itself. Predominating (still) is an authoritarian management style and, as regards the staff, a tendency to leave all decisions to the boss.

A deficit in motivation is due in the first place to the relatively low salaries and to the rigid distribution of competencies and the narrowness of individual fields of activity and responsibility connected with that.

The railway engineers formerly especially trained in the Moscow Railway Institute are no longer followed by adequately trained junior staff, since the training (now taking place abroad) is beyond anyone's financial means. Whenever elder staff are leaving the company there is a lack of technically qualified, competent personnel.

Problems connected with competition (amongst others, with roadbound transport), with marketing and with special customer services and modern working methods and structures did not play a sufficiently large role or were not further propagated in the enterprise. The old thinking still prevails that "the customer is the one who wants something" and has to come to the railway to "ask" for a service to be rendered.

The assignment of further training measures is preferably done according to formal aspects. Modern working methods, management techniques, marketing, work with the customer, command of foreign languages, and service quality - all these pillars of survival in competition - are hard to be found there.

The present organisational structure of the Azerbaijan State Railways (AGZD) and the Georgian Railways (GRZD) is presented in Annexes 2.1-1 and 2.1-2.

The relevant regulations and instructions for freight transport had been analysed within Module B "Pilot train Baku - Tbilisi - Poti/Batumi"

- at the national level
- at the transport companies' level (rail and road transport)

with regard to their range of application, their implementation and effectiveness. Special attention has been given to the framework of relationships between the railways and their customers, to the organisation of cooperation between the Azerbaijan and Georgian railways and the organisation of internal commercial and operational procedures. A special management system for the implemented Pilot train had been worked out. The results and recommendations for necessary amendments regarding organisation of management, cooperation, transport services, tariffs as well as marketing activities are presented within the Draft Final Report on this part of the project.

The situation of the railways within the transport system of the two countries, questions concerning the relationship between the different modes of transport, especially the relationship between road and rail transport under developing market conditions are dealt with in chapter 2.2.1 "Traffic volume forecast".

The general investment policy of the two countries in the area of the whole transport system as well as in the field of railway transport had been analysed within chapter 2.2.2 "Revenue forecast" and chapter 4 "Financial pre-feasibility. Special attention within this complex was focused also on the organisational set-up in the areas of finance and accounting. For results and recommendations compare the respective chapters.

Problems concerning organisation and institutional conditions in the field of infrastructure are analysed within chapter 3 "Technical pre-feasibility". Attention was focused on the question of what conditions exist and what conditions have to be created for enabling the railways to conduct the necessary repair and maintenance work on the whole network and especially on the Baku - Tbilisi - Poti/Batumi line to uphold a permanent operation of a high-profile service in the field of freight transport.

The track and constructional work maintenance organisation of the two railways is analysed in chapter 3.1. Methods and organisation of maintenance as well as weaknesses and limitations are shown, the necessary recommendations have been drawn up. The same refers to the rolling stock (chapter 3.2) and the signalling and telecommunication systems (chapter 3.3).

Final Report Module A

Chapter 2 Institutional, organisational and commercial pre-feasibility

2.2 Commercial pre-feasibility

2.2.1 Traffic volume forecast

2.2.1 Freight traffic forecast

2.2.1.0 Introduction

Apart from the general problems in drawing up a forecast for traffic development under the current political and economic conditions in the region, explained in the following chapter, there were additional difficulties due to existing problems in making available the necessary statistical reference data. Whereas relatively detailed internal statistical data on the development of traffic could be made available by the Azerbaijan Railways, the Georgian Railways have not got available such detailed data.

Unfortunately, there is scarcely reliable data on road transport in all countries.

The very informative Azerbaijan statistics on foreign trade offered an important basis for drawing up the forecast. Furthermore, national foreign trade statistics of Western European and Central Asian countries as well as of the CIS were included in the investigations. A great number of different other sources, e.g. customs, trade authorities, industrial companies, forwarders had to be utilised for data collection.

Due to the data availability described above, assumptions or own calculations were necessary in many cases to work on. These cases are explained in detail in the following.

There was close coordination and data exchange with other running relevant TRACECA projects, especially with:

- Regional traffic forecasting model
- Forwarding / Multimodal transport system
- Technical assistance for the development of the Port of Baku
- Port network plan and improvement programme

The results of the forecast of freight traffic have been discussed and harmonised with the local authorities. After discussions with the railway administrations, the Ministry of Transport of Georgia, the Ministries of Economy of Georgia and Azerbaijan, the results presented in the Interim report had been slightly amended. This concerns mainly the transport volumes of oil products, especially in the pessimistic scenario, as well as the transit traffic from and to Central Asia.

2.2.1.1 Methodology

Traditional mathematical and statistical methods of traffic forecasts, normally used under West European conditions, do not apply to the prognosis of traffic flows under the current situation in East European countries. These methods would lead to very imprecise results, under the conditions prevailing in the successor states to the Former Soviet Union (FSU), at the moment. The most important reasons, which make a different methodological approach necessary, are:

- The disintegration of the Soviet Union and the transition from the centrally planned economy to market economy structures have led to thoroughgoing structural changes in politics and the economy;

- The traditional economic, trade and clearing relations between the former Soviet republics have more or less all collapsed. The trade relations of the republics investigated are currently undergoing a completely new geographical and structural orientation;

- The former strong central influence on the role of the individual modes of transport led to a state approved modal split, which is now being influenced more and more by the conditions prevailing on the market;

- There is no detailed statistical data base on production, trade and traffic. Existing data is partly incomplete or the information is severely limited. Statistical time rows for the previous period of time are without informative value due to the considerable structural amendments or the changed statistical registration methods.

Due to the reasons mentioned, a methodology was applied in drawing up the traffic volume forecast, tailor-made for the conditions of the East European reform states.

This special methodology of the Consultant includes the following main elements:

The most important initial item to be analysed for assessing the future traffic volume is the development of the main economic indices, especially the Gross Domestic Product (GDP). The assumption is that there is a close connection between the development of the GDP and the total traffic volume of a country, which has been extensively proved by analogue investigations in various East European countries and for different periods of time.

The development of selected branches of the economy, which are of special importance for the traffic volume of the railways, have been assessed in detail to further verify the forecast. These are above all the oil processing industry, the chemical industry, the non-ferrous and ferrous metallurgy, the building materials industry as well as agriculture, for the respective period of investigation.

The foreign trade relations are of special significance for the development of the freight traffic volume. That is why very detailed investigations were conducted on the current and the future structures and trade volumes. The studies also included the foreign trade relations of other countries, which are of interest especially for the transit traffic of the region, e.g. the Central Asian republics, Russia, Turkey, Iran.

The possible development of the mentioned factors is depicted in two scenarios, an optimistic and a pessimistic one.

On the basis of assessing all these above-mentioned factors and a special interlinking of them annual growth rates were deducted for the development of the transport volume in the mentioned railway traffic for the period up to 2015, divided according to domestic traffic, export, import, transit and that in the respective two scenarios.

The statistical data for 1995 served as reference figures. Separate assumptions on the production and trade volume were made for individual types of goods, which are of particular importance for the total traffic volume. These assumptions are described in the following. This applies especially to the oil processing sector, cotton, and container traffic.

The traffic volume for important transport corridors was established on the basis of these statements on the development of the total traffic. In doing so, the pertaining development rates for the individual segments (export, import, transit, domestic traffic) were used, and where necessary, they were harmonised with the data of neighbouring railways. The establishment of a reliable starting level posed a problem for those transport corridors along which there is no or a very limited freight traffic due to the political tensions in the region. The respective approach chosen is explained in detail in the relevant section.

2.2.1.2 Development of GDP

The assessment of the possible development of the Gross Domestic Product, as one of the most important economic indices, was conducted with the help of an analysis of the economic and political situation, based on selected important factors such as

- political stability,
- climate for investment,
- situation of the national economy,
- stability of the money value / availability of foreign currency,
- foreign trade as well as
- the stage of the reform process.

Furthermore, similar investigations conducted by the World Bank, the IMF and the World Food Program were included in the assessment.

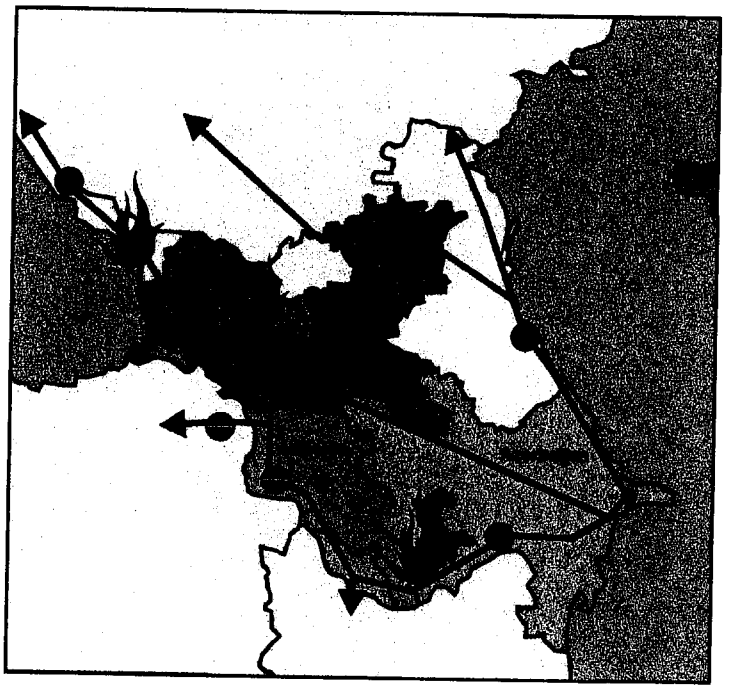
As the calculation of the GDP is conducted very differently in the individual countries, and especially the statistical reference figures available in the three countries are relatively unreliable at present, this investigation was carried out without using absolute figures for the GDP. The assessment was drawn up on the basis of the annual percentage of change, using the year 1989 as the year of reference. The width and breadth of a possible development is depicted in an optimistic and a pessimistic scenario, separately for each country.
Despite all care taken in the analysis of the economic situation, a forecast of the socio-economic development of the Caucasus republics is connected with a great amount of insecurity, due to the unstable political situation of the region.

2.2.1.2.1 Political situation

At the moment, the entire region of the Caucasus is covered with manifold flashpoints of conflicts. National, ethnic and religious disputes, often connected with military con-

frontations, have led to a severe impairment of the economic situation in the region. The existing, historically grown transport system is especially badly affected, above all the inter-regional and international rail links. Such important lines as Baku - Nakhichevan - Dshulfa - Iran, Baku - Yalama - Russia or Tbilisi - Sukhumi - Russia have been either completely closed down or strongly restricted due to the political conflicts.

Fig. 2.2.1-1: Political situation in the Caucasus region



The future political situation in the region will influence the further economic situation in Azerbaijan and Georgia decisively and thus the situation of the railways.

Azerbaijan

Stable domestic political conditions continue to prevail in Azerbaijan. The process of democratisation is progressing further.

The economic situation of the country is still severely strained by the conflict surrounding Nagorno-Karabakh. At the moment, a solution of the conflict is hard to asses, especially as regards the time schedule. There are first indicators which signal readiness for a negotiated settlement. The railway connection to Nakhichevan is severed, whereby this part of Azerbaijan is hardly accessible by road (only via Iran). Traditional transport ways from and to Russia are also barely usable due to the conflict in Chechnya.

The further economic development over the years to come will be determined above all by the political situation in the region.

Georgia

Religious and ethnic conflicts and nationalistic sentiments have led to serious civil disturbances in several areas of the country.
The political situation inside the country has stabilised following the election of E. Shevardnadse as President. The interior order was re-established. Nevertheless, there is still an internal potential of conflict, which should not be underestimated, even today. The further political stabilisation, especially the solving of the problems of Abkhasia, South Ossetia and Adsharia will influence decisively the future economic situation of the country.

2.2.1.2.2 Makroeconomic development

Azerbaijan

The economic decline of Azerbaijan started at the beginning of the '90s. Until 1995, the GDP dropped to about a third of the 1989 level. The situation was especially bad in the years of 1992 to 1994 with an annual fall of the GDP by more than 20 per cent. The downward trend in the economy has not been halted in 1996, but it did slow down as of 1995. Great hopes for stopping the decline of the GDP are linked to the start of oil production at the new off-shore oil fields as of 1997.

In agriculture and industry it seems as if the trough has been reached and soon there could be a slow start of an upward trend. In selected areas, there were first increases in production in 1996.

The economic symptoms of crisis were aggravated further through the military conflict over Nagorno-Karabakh as well as the more or less complete breakdown of the trade and payment transactions with the countries of the former Soviet Union.

Apart from the development of the oil industry, the boosting of further branches of the economy (e.g. chemical industry in Sumgait, mechanical engineering), the extension of the services sector as well as the re-structuring of agriculture are necessary for a balanced development of the Azerbaijan economy.

The reform process in Azerbaijan has made only relatively slow progress up until now. Structural reforms of the economy have only been tackled hesitantly. The privatisation process only started slowly in 1995. A law on privatisation was passed. However, legislation still requires serious revision. Up until now, the development of the private sector has been hampered through the lack of respective legal prerequisites. The small privatisation has started slowly. The privatisation of medium-sized and large industrial companies was to be started in 1996.

The following scenario formed the basis for predicting the GDP development:

Optimistic scenario	Pessimistic scenario
Political situation:	
❒ stable domestic political conditions	❒ growing social problems will put a strain on the internal stability
❒ the conflict of Nagorno-Karabakh will have been settled peacefully by the year 2000, and there will be no further strains on the economic development anymore	❒ the problem of Nagorno-Karabakh will be solved by the year 2005 at the earliest, so that important transit corridors will still not be available until that point in time
❒ the situation in Chechnya will stabilise to such an extent up to the year 2000 that international railway transports will not be hampered anymore;	❒ due to sustained tensions in Chechnya, important international transit links will continue to be interrupted;
Development of the national economy:	
❒ AIOC will start oil production as scheduled in 1997; production will be extended to 35 million t/a up to 2010 (see section 3.1.3)	❒ due to a great number of problems, production of the 'early oil' by AIOC will not start in 1997, production volumes will remain well below the originally planned figures until the year 2000
❒ the development of the oil industry will lead to an upswing of the other branches of economy, especially the processing industry	❒ other branches of industry will lag behind the growth rates of the oil sector considerably; foreign investments will concentrate on oil production;
❒ favourable framework conditions and the development of the oil industry will lead to rising international investments, also in other branches of the economy;	❒ due to quality and other problems, national companies will only be included to a limited extent in the delivery and service in connection with the oil production;
❒ national companies will be included more and more in the supplies and services for oil production	❒ delays in the reconstruction of the oil processing plants will lead to capacity losses in the medium term;
❒ the national oil processing capacities will be reconstructed or developed speedily and supplied with crude oil in the scope of the max. capacity (see section 3.1.3.1);	
Policy of reform	
❒ the course of reforms in the direction of the market economy will be continued unerringly;	❒ hesitant steps towards the market economy, sustained strong central state influence will hamper economic development;
❒ the privatisation of medium-sized and large companies will continue;	❒ continuing problems in privatising the economy, especially the medium-sized and larger companies;
❒ the missing legal conditions will be established shortly;	❒ lacking legal prerequisites and conditions will lead to a reserved commitment of international firms;

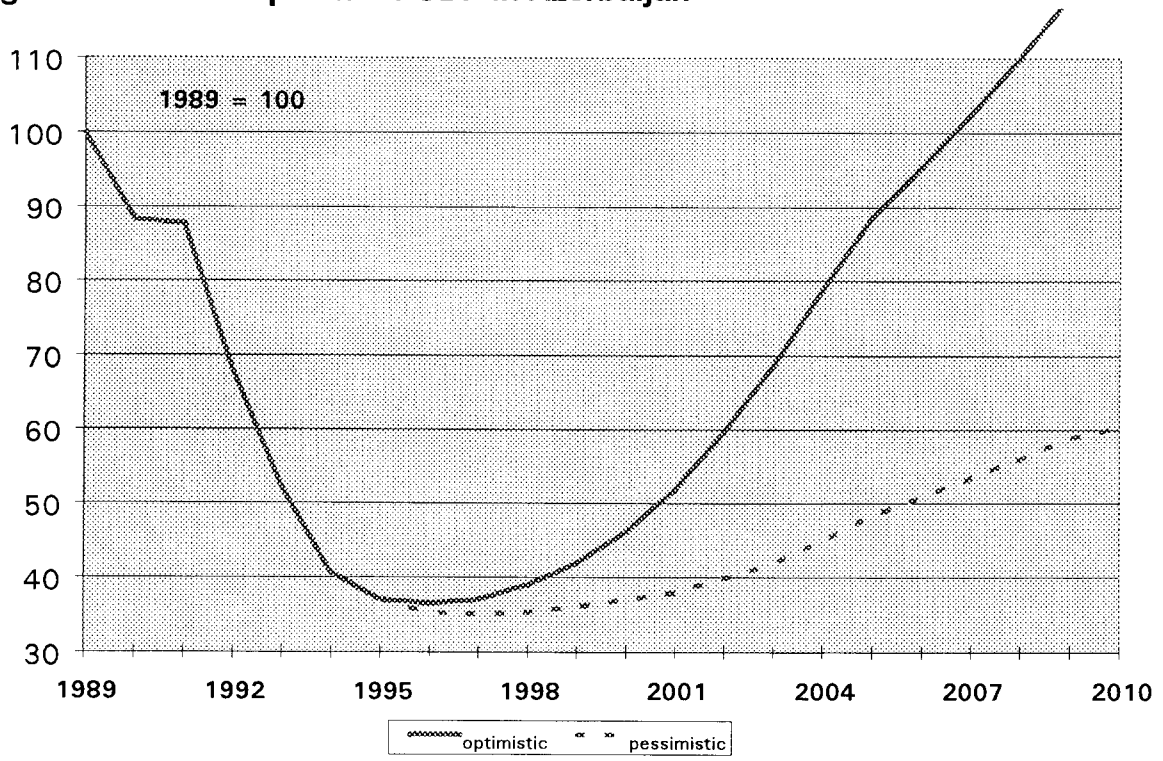
For the development of GDP of Azerbaijan the following range of annual growth rates has been determined:

	1997 - 2000	2001 - 2005	2006 - 2010	2011 - 2015
optimistic	5 ... 10 %	12,5 ... 15 %	5 ... 7,5 %	5 %
pessimistic	0,5 ... 2,5 %	2,5 ... 7,5 %	5 %	2,5 ... 5 %

Based on these framework conditions, the Gross Domestic Product of Azerbaijan will develop as follows:

- The trough of the economic development was reached in Azerbaijan by 1996, at a very low level as compared to 1989;
- The future development of the GDP in Azerbaijan will be determined decisively by the oil sector;
- Thanks to the steeply increasing oil production in future, strong growth impulses will result also for the other economic areas, that is why the forecast growth is higher than in Armenia and Georgia;
- Due to the very low reference level, the forecast growth rates are much higher during the first years and decrease markedly later on;

Fig. 2.2.1-2: Development of GDP in Azerbaijan



Georgia

In Georgia, too, the GDP dropped continuously in the period between 1989 to 1995, and in 1995 it was at about 35 per cent of the 1989 level. There was a deterioration of the economic situation, especially in 1992/93, in connection with internal political problems.
The economic state of Georgia is influenced decisively by the energy situation in the country. Over the past years, bottlenecks in the energy supply of the economy, traffic and the public led to an additional decrease in production.
The economic decline of the country slowed down the first time in 1995. In 1996, there is a standstill or a slight upward movement in individual branches of the economy.

The following scenario forms the basis for the further development:

Optimistic scenario	Pessimistic scenario
Political situation:	
❒ the internal political situation in the country will remain stable, ❒ there will be no internal unrest due to social problems; ❒ the conflicts of Abkhasia and South Ossetia will be dissolved by the year 2000 so that they will not influence the economic development negatively any longer;	❒ socio-economic conflicts will burden the internal stability, making more difficult a continuous, consistent policy of reform; ❒ the national conflicts (Abkhasia, South Ossetia) will not be resolved until the year 2000, so that the economic development, especially the transport links, will be influenced negatively further;
Development of the national economy:	
❒ the problems in energy supply of the country will be resolved in the short term; ❒ branches of industry which work on the basis of domestic raw materials will be developed at an exceptional speed (non-ferrous and ferrous metallurgy, building materials industry); ❒ income from international transit transports will lead to further impulses for the economic development of the country	❒ the problems of energy supply cannot be solved satisfactorily in the medium term and will lead to further obstruction of industrial production; ❒ existing domestic raw materials will be exported at a relatively low level of processing, the own processing industry develops with insufficient speed; ❒ lacking income from international transit transports will limit the investment possibilities of the country severely;
Policy of reform	
❒ the course of reforms in the direction of the market economy will be continued unerringly; ❒ the restructuring process of the national economy will be accelerated ❒ the privatisation of medium-sized and large companies will continue;	❒ hesitant steps towards the market economy, sustained strong central state influence will hamper economic development; ❒ continuing problems in privatising the economy, especially the medium-sized and larger companies; ❒ lacking legal prerequisites and conditions will lead to a reserved commitment of international firms;

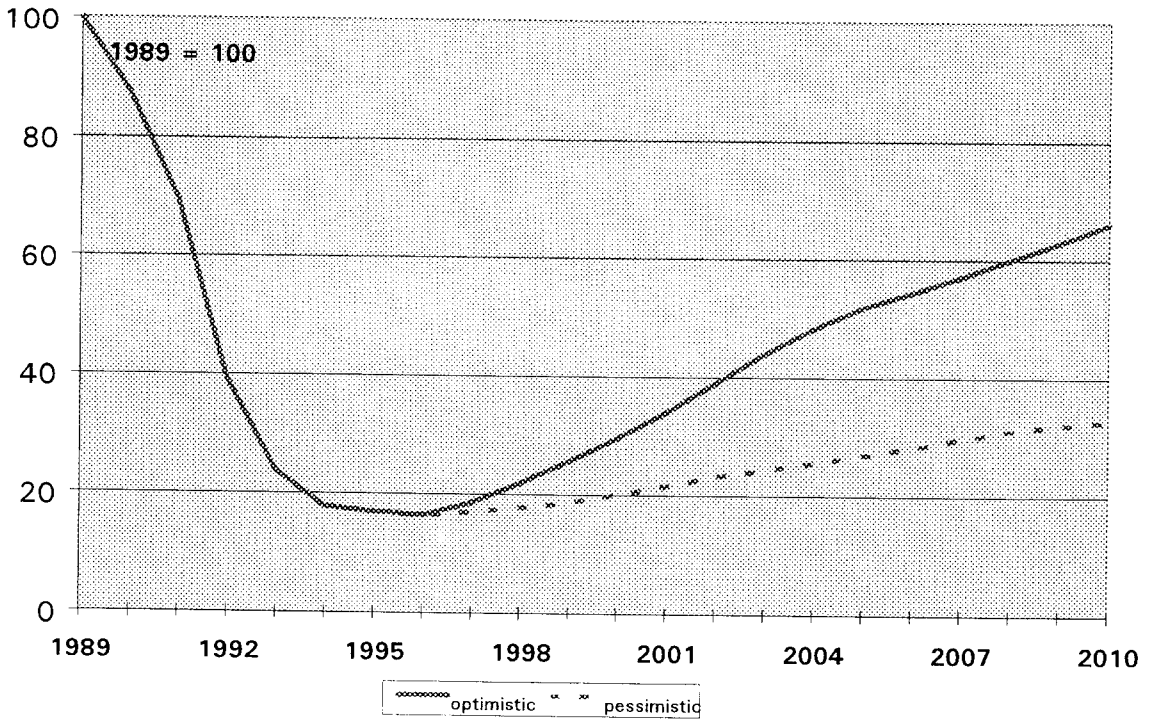
For the development of GDP the following range of annual growth rates had been determined for Georgia:

	1997 - 2000	2001 - 2005	2006 - 2010	2011 - 2015
optimistic	12,5 ... 17,5 %	7,5 ... 15 %	5 % ... 7 %	3 ... 5 %
pessimistic	2,5 ... 7,5 %	5 ... 7,5 %	4 ... 6 %	2,5 ... 5 %

(A World Bank study "Georgia - Public Expenditure Review", 1996, contains the following GDP growth rates: 1997/98 - 10 %, 2000 - 8 %, 2004 - 5 %).

This scenario leads to the development of the GDP depicted in the following:

Fig. 2.2.1-3: Development of GDP in Georgia



2.2.1.3 Development of main branches of national economy

2.2.1.3.1 Oil industry of Azerbaijan

Oil production and processing is by far the most important branch of the country's economy. The oil industry yields about 68 per cent (1995) of the total industrial production of the country.

The oil production and processing sector in Azerbaijan currently is a highly delicate field both in terms of politics and economy. Differing national interests and views of the States bordering the Caspian Sea as regards the distribution of the available re-

sources are clashing. Political and economic interests of the states in the region are influencing or complicating decisions as to the course of the pipelines for crude oil transport, and are impeding or delaying their construction. In the long run the starting of full-scale production of oil by the international consortiums will considerably influence the situation on the world market for oil. All these factors contribute to the current reservedness of national and international authorities in making available data and information, especially with respect to future production volumes of crude oil and its use.

Crude oil production

Oil production has decreased since 1989. It dropped from 13.2 million tons (1989) to 9.1 million tons in 1996.

Tab. 2.2.1-1: Crude oil production of Azerbaijan

(in ,000 tons)

	1989	1992	1995	1996
Total	13,159	11,195	9,161	9,101
Onshore	*3,023*	*1,970*	*1,520*	*1,569*
Offshore	*10,136*	*9,225*	*7,641*	*7,532*

In the year 1997 the production of about 9 million tons is planned by the national oil company (SOCAR).

In 1994, a contract between Azerbaijan and an international consortium (AIOC) was signed on the exploitation of the off-shore oil fields in the area of Baku. The consortium will start producing the so-called 'early oil' in 1997. At the moment, there are no exact statements on possible production volumes, however, experts think that production could amount to 0.2 million tons in 1997. For the years to come, figures on the possible AIOC production amounts also differ strongly. They are between 3.5 and 10 million tons per year in 2000, with a lower amount being more probable. Oil production is to reach 35 million tons a year in 2010. Apart from the contract with AIOC, four more contracts have been concluded with international consortiums or companies for oil production in Azerbaijan.

In 1994 0.85 million tons of crude oil were imported, mainly from Kazakhstan, and refined in Azerbaijan. In 1995 the amount of imported crude oil was down to 0.06 million tons due to the blockade of the railway line through Dagestan.

Oil refining

Azerbaijan has oil processing capacities in Baku. The capacity of the refineries is currently some 12 million t/a, this figure stood at 24 million tons in 1990. At present, this existing potential is not even being used to the full, as their is not enough crude oil available.

Presently, the outdated technology and the poor state of maintenance of the refineries are the main reasons why the oil refining industry is not extracting the maximum value from Azerbaijan's high-quality crude oil. Due to their limited upgrading capability, the refineries produce a relatively large volume of fuel oil. The principal components of the current output mix are fuel oil (49.2 %), diesel oil (24.3 %), petrol (11.7 %), kerosene (6.9 %) and lubricants (2.6 %).

Tab.: 2.2.1-2: Production of oil products in Azerbaijan

	,000 tons	%
1991 Total	**13,639**	
1995 Total	**8,923**	**100.0**
of which		
Petrol	1,040	11.7
Kerosene	617	6.9
Diesel	2,168	24.3
Fuel oil	4,391	49.2
Lubricants	231	2.6
others	476	5.3

6.7 million tons (75.5 %) of the oil products were produced for domestic consumption in 1995. This mainly concerned fuel oil and petrol.

The produced fuel oil was used to a large extend for electricity generation. Approximately 90 per cent of the country's electricity production is generated by thermal stations, which are powered by dual cycle oil and gas system. All of the thermal power stations have been switched from gas to oil burning recently after Turkmenistan sharply raised gas prices. The main thermal power stations are located in Mingechaur, Ali-Bairamly and Sumgait. (For transportation of fuel oil to power stations see below). To return all dual-cycle power stations to gas burning would require an additional amount of about 4 billion cubic metres of natural gas which will not be available before 2004. Presently Azerbaijan experiences a gas supply deficit of about 1 billion cubic metres.

About 10 per cent of electricity output is generated by hydroelectric stations (Mingechaur).

Notwithstanding the high quality of domestic crude oil, the outdated refinery technology does not allow the production of sufficient amounts of highly refined products so far. That's why investment in the refinery industry aims to increase the depth of refining.

The oil processing industry is extremely important to the Azerbaijan economy. The share of this branch in the country's industrial production in 1995 amounted to nearly 50 %. It is therefore legitimate to assume that this branch of industry will keep playing an important role in Azerbaijan's economy, and that the existing processing capacities will be reconstructed and expanded accordingly; particularly since in future sufficient, high-class crude oil out of domestic production will be available.

According to various consultations the consultant has had on the problem of developing prospects of the oil processing industry with national experts of the oil industry, the Azerbaijan oil refineries and economic experts, it is assumed that the oil processing industry is going to develop as follows during the forecast period (in million tons):

	optimistic	pessimistic
2000	16.5	9.5
2010	22.0	14.0
2015	25.0	15.5

This is based on the assumption of a corresponding extension of the processing capacities as well as the provision of the necessary crude oil amounts.

In 1994 about 1 million metric tons of crude oil from Kazakhstan were processed in Azerbaijan refineries. It cannot be expected, however, that in future large quantities of crude oil from Kazakhstan will be processed, since the Kazak oil is of minor quality (high content of sulphur) and thus is an ecological hazard. What is more, the import-export business related to the processing of foreign crude oil is not very profitable.

Exports of oil products

The products of the oil processing industry are of extraordinary significance for the foreign trade of Azerbaijan as well as for railway transports. Altogether, Azerbaijan exported 2.19 million tons of petrochemical products in 1995, which was about 20 per cent more than the previous year.

Tab. 2.2.1-3: Azerbaijan exports of oil products

	1994		1995	
	,000 t	%	,000 t	%
Total	1,803	100.0	2,190	100.0
Petrol	0	0.0	89	4.1
Kerosene	132	7.3	189	8.6
Diesel	1,507	83.6	1,625	74.2
Fuel oil	58	3.2	126	5.8
Lubricants	101	5.6	120	5.5
others	5	0.3	41	1.8

Analogous to the changes in the production structure mentioned above the structure of the products to be exported will change to products with a deeper stage of refining.

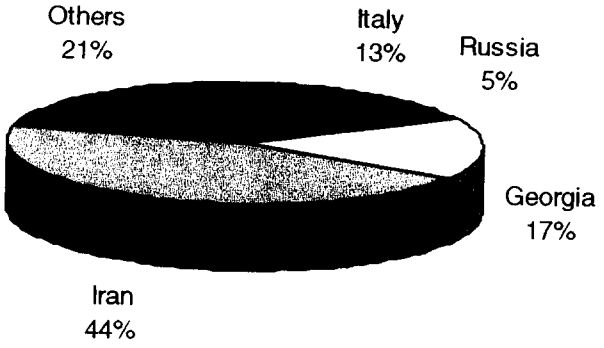
Iran was the largest importer of Azerbaijan petrochemical products with 1.045 million tons in 1994 and 0.976 million tons in 1995. 44.6 per cent of the total export of oil products went to Iran. This quantity was transported by ship to Iranian Caspian sea

ports. Georgia was the second largest recipient in 1995 with 0.364 million tons. The share of the CIS countries stood at about 30 per cent (comp. Annex 2.2.1-8).

Main buyer countries for Azerbaijan oil products will be the countries of the region: Iran, Georgia, Russia, Ukraine, Armenia (once the political problems will be solved), and further States bordering the Black Sea. These countries are a relatively reliable market with a demand potential as yet not utilised to the full. Azerbaijan as a supplier of oil products offers itself particularly because of the favourable transport distances. Its importance will grow along with the increasing refinement of processing and growing quality of the products.

At present, Iran is importing oil products (mainly diesel) from Azerbaijan, since its own processing capacities are mainly located in the south. Thus the supply of Iran's northern regions with products from Azerbaijan is favourable under aspects of transport economy. Furthermore, these exports presently serve to finance deliveries from Iran for the supply of Nakhichevan. Thus for the next years Iran appears to be a relatively stable market for Azerbaijan oil products.

Fig. 2.2.1-4: Main importers of Azerbaijan petrochemical products (1995)



Transportation of oil products

Oil and oil products represent the commodity type group with the largest transportation volume for all three railways. 74.3% of the freight dispatch of the Azerbaijan Railways in 1995 were oil products, and it was 46.0 per cent of the entire transportation volume in the case of the Georgian Railways in the same year. 30 per cent of the freight reception of the Armenian Railways were oil products in 1996.

In Azerbaijan, 8.923 million tons of oil products were produced in 1995. 6.416 million tons out of this figure, that is to say 72 per cent, were transported by railway. Another 0.976 million tons were transported on the sea route (export to Iran). And 17% of the entire transport volume was handled by road transport.
The domestic rail transport of oil products concerned mainly fuel oil for the thermal power stations of the country. The entire quantity is delivered by the refineries in Baku. The main recipients are (figures for 1995, in ,000 tons):

Thermal power plant Mingechaur	2,185
Thermal power plant Ali-Bairamly	1,050
Heat and power stations Sumgait	0,820
Power station Mardakan	0,350
Heat and power station Gyandsha	0,050

In 1995, Azerbaijan exported 2.19 million tons of oil products. Some 49 per cent were transported by rail, 45 per cent of the total export volume went by sea, and the remaining 6 per cent of the entire export volume was transported by road.

Export by rail in 1995 was distributed as follows along the main corridors (in '000 tons):

Total	**1,064**
Baku - Beyuk-Kyassik (Georgia)	942
for Georgia	*364*
in transit through Georgia	*578*
Baku - Yalama (Russia)	98
Baku - ferry to Turkmenbashi	24

74 % of the entire export volume was made up of diesel fuel, the railways did not transport any crude oil for export.

Furthermore, 136,000 tons of oil products were transported in transit from Central Asia along the corridor of Turkmenbashi - Baku - Beyuk-Kyassik (Georgia).

In Georgia, some 75 per cent of the oil product transits channelled through the Black Sea ports were shipped at Batumi, in 1995. In the same year, Georgia imported 713 thousand tons of oil products via Poti and Batumi. Out of which 379 thousand tons were for domestic consumption and 334 thousand tons for transit (mainly to Armenia).

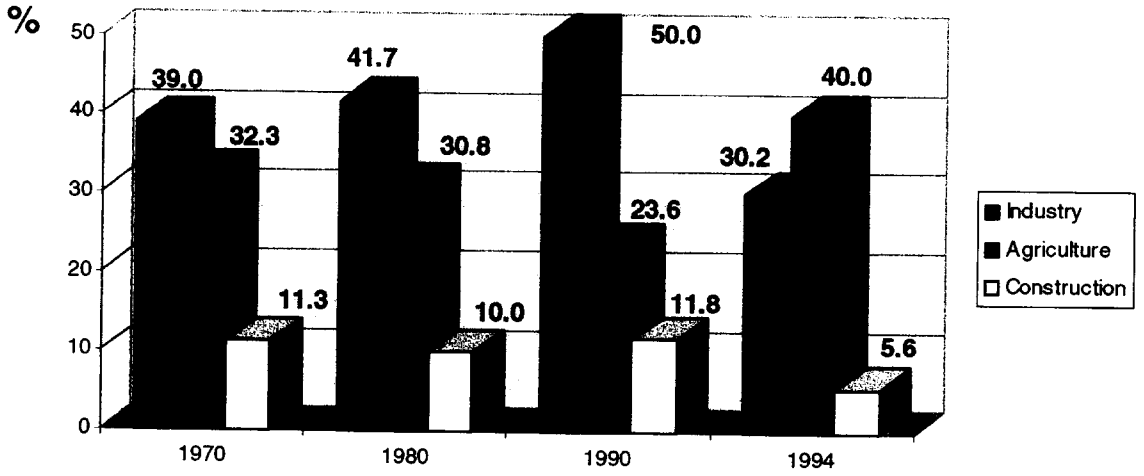
For the future development of transportation of oil products see section 2.2.1.6.3

2.2.1.3.2 Other branches of industry

Azerbaijan

The share of industrial production in the produced national income of Azerbaijan has dropped constantly over the past years:

Fig. 2.2.1-5: Share of industrial branches in the produced national income of Azerbaijan



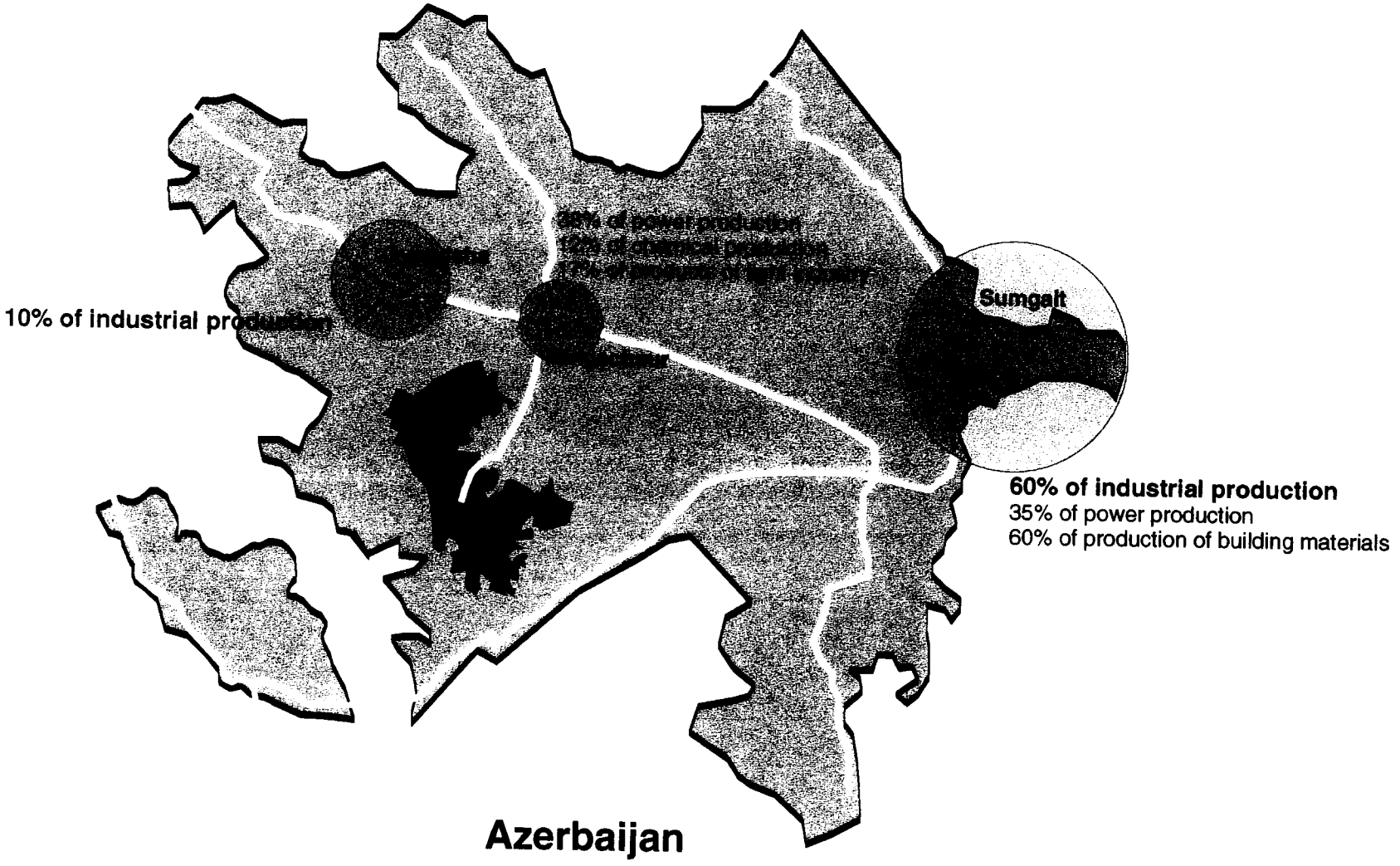
The main industrial locations of Azerbaijan are distributed very irregularly across the territory of the country. The most important region by far is the Apsheron peninsula with Baku and the industrial complex of Sumgait, which concentrate some 60 per cent of the country's industrial production., The second most important industrial region is the area around Gyandsha, where some 10 per cent of industrial production of the country is located (comp. Fig. 2.2.1.6).

As mentioned above oil production and processing is the most important branch of the country's economy, accounting for about 68 per cent (1995) of the total industrial production of the country.

Apart from oil production and processing, the development of the economic zone of Sumgait is of special importance for the economic rise of the country. The main branches of industry in Sumgait are the metallurgical industry, the aluminium industry, the chemical industry. The present capacity of some selected plants and factories of the Sumgait region is as follows (tons per year): Azerbaijan Pipe and Tube Works - 600,000 tons; Sumgait Aluminium Smelter - 55,000 tons; chemical and petrochemical industries: ethylene - 260,000 tons, propylene - 180,000 tons, detergents - 90,000 tons, caustic soda - 180,000 tons, chlorine - 160,000 tons. These capacities are presently only partly used, mainly by reasons of raw material shortages and poor technical conditions of the installations. With the help of international organisations (for example the United Nations Development Organisation - UNIDO) and foreign investors, the modernisation of the plants is planned, especially with the aim of increasing the share of final products.

Azerbaijan has significant deposits of rich iron ore in the Dashkesan area, which was formerly used to supply reducing plants in Georgia and other FSU states. Near Dashkesan there are rich deposits of alunite. The proven reserves of alunite of about 300 million tons are reported to be among the largest deposits in the world.

Fig. 2.2.1-6: Main industrial centres of Azerbaijan



(as per 1994/95)

The aluminium refinery at Gyandsha processes bauxite as well as the locally mined alunite. The capacity of the refinery is about 500,000 tons of aluminium p.a., but the current output is down to only about 10 per cent of this amount.

Georgia

The structure of the economy is changing significantly. Industry is on a relative decline, in 1996 it accounted for 14 per cent of value added, compared to 24 per cent in 1990. The service sectors have been increasing their share in GDP fast during the last years, accounting for about 43 per cent in 1996. The construction sector is growing, too. It accounted for 5 % of GDP in 1996.

The industrial sector is recovering very slowly. About 33 % of the industrial enterprises were not working by the end of 1996. Capacity use ranges from just over 20 % in chemical production to 5 % in machine building.
The structure of industry is beginning to change. Mining, electricity, food processing and non-ferrous metal production are increasing their relative share. Mining accounted for 26.5 % of industrial output in 1996, food processing for 22.2 %. Fuel and building materials production are also growing fast.

The products from the iron and steel plant at Rustavi count among the country's most important products of industry. The plant has an annual capacity of 1.5 million tons of steel, of which only 5 % are used at present. However, reconstruction and expansions by means of investments from abroad are already under planning, so that increases in production can be expected for as early as 1997.

A further investment project of top priority is the modernisation of the coal industry. While until 1989 up to 3 million tons of coal per year were being extracted, at present it is only about 50,000 tons per year. By 2005 the production is scheduled to have risen again to about 1 million tons per year.

Figures for production by region emphasise the dominance of Tbilisi, with about 30 % of Georgia's industrial output in 1996.

2.2.1.3.3 Agricultural production

The natural conditions for agricultural production differ strongly as to the region.

At the moment, agriculture in all countries is experiencing a deep crisis. Drastic slumps in agricultural production over the past years are due especially to the following causes:

- internal unrest and wars
- disappearance of traditional markets in the other former Soviet republics
- scarcity or drastic rise in the price of the means of agricultural production

In the past, ***Azerbaijan's*** agriculture was developed primarily as a source of raw materials for the Soviet economy, with only limited domestic processing of agricultural

products. About 80 per cent of total agricultural land is irrigated, and half of this area suffers from salinization. Agriculture suffers from machinery and input shortages. The slow progress with privatisation and land reform, moreover, has delayed the restructuring of agricultural production and trade necessary for the development of new markets.

The production of main agricultural commodities is shown in the following table (for cotton see section 2.2.1.6.3).

Tab. 2.2.1-4: Production of main agricultural commodities in Azerbaijan

(in 1,000 tons)

	1991	1992	1993	1994	1995
Grain	1346	1285	1100	1039	1100
Potatoes	180	156	152	150	200
Vegetables	805	555	488	471	500
Fruits	496	401	346	323	324
Dairy products	175	81	50	40	10
Milk	948	850	798	784	789

Agriculture in ***Georgia*** is the largest source of value added in the country's economy. The sector accounted for 32 per cent of the GDP in 1996. Agricultural production figures are more significant than those for industrial production. Production of grain and vegetables has increased since independence. However domestic wheat production accounts for only a quarter of domestic consumption. The country's traditional export crops of grapes, tea and to a lesser extend citrus have all declined over recent years, mainly due to the loss of traditional export markets within the former Soviet Union.

Tab. 2.2.1-5: Production of main agricultural commodities in Georgia

(in 1,000 tons)

	1992	1993	1994	1995	1996
Grain	526	426	493	525	650
Vegetables	308	357	443	428	540
Potatoes	255	247	297	353	350
Grapes	175	71	13	39	58
Other fruits	337	270	373	384	250
Citrus	108	70	89	90	96
Tea	212	133	62	37	32

The agriculture of Armenia, Azerbaijan and Georgia will mainly produce for their own demand, in the medium-term. Significant export and thus transport potentials are not

to be expected from this branch of the economy (with the exception of a few selected products such as cotton, tea, citrus fruit).

2.2.1.4 Development of foreign trade

With the disintegration of the former Soviet Union, the foreign trade relations of Azerbaijan and Georgia also experienced thoroughgoing changes. The economic symptoms of crisis, especially the decline of industrial and agricultural production, have led to a sharp drop both in exports as well as imports.

In the past, the volume and direction of goods flows were determined above all by a strong specialisation of production, which led to a high degree of dependence on raw materials deliveries and the mutual supply of goods in process and intermediate products. Thus, the more or less complete collapse of the trade and payment transactions with the countries of the former Soviet Union is another decisive factor for the radical changes in the foreign trade relations of the Caucasian republics.

In the Caucasus republics as well as in the Central Asian republics of the former Soviet Union, there is currently a geographical re-orientation of the international trade relations. What is characteristic for these new geographical structures is a more or less strong decline in the goods exchange with the former Soviet republics, especially with Russia, and a growing share of Western industrial states. Iran and Turkey play a special role in the foreign trade of the region.

2.2.1.4.1 Azerbaijan

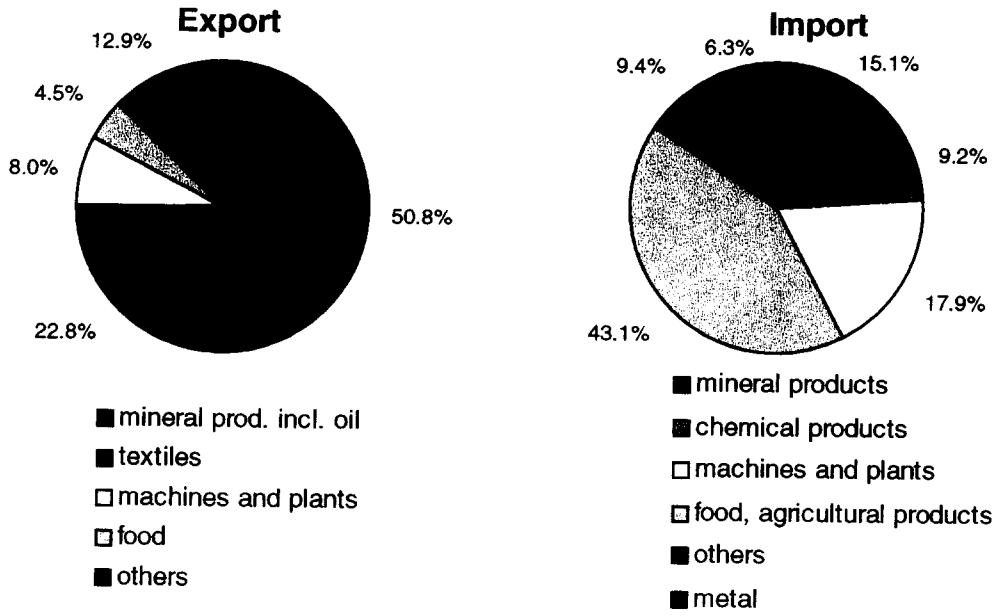
In connection with the conflicts in the Caucasus, a drastic decline in the foreign trade turnover of Azerbaijan started in 1988. A further strong reduction in the following years was due mainly to the disintegration of the former Soviet Union and the economic crisis starting at the beginning of the '90s.

In 1995, some 26 per cent of the goods produced in Azerbaijan were exported. About 22 per cent of the goods consumed in the country were imported. Thus there is a relatively high degree of foreign trade activity.

The main proportion of the Azerbaijan exports is made up of the products of the oil processing industry. In 1994, they constituted some 35 per cent of the entire exports, in 1995 the share rose to more than 50 % (on value basis). Products of the textile industry were the second most important item with 18 and 23 per cent respectively. The metallurgical products made up 16 and 3 per cent.

The goods structure of the Azerbaijan foreign trade (on value basis) is depicted in the following chart. A detailed overview is contained in Annex 2.2.1-3.

Fig. 2.2.1-7: Commodity structure of Azerbaijan foreign trade in 1995
(in % of total value)



From the transport point of view an assessment of foreign trade flows by volume is even more interesting. The extraordinarily high share of products from the oil processing industry is especially striking when looking at the forwarded amount of goods. In 1995, they made up roughly 80 per cent of the goods exported in total.

The following table contains the most important export items of Azerbaijan. A detailed overview is shown in Annex 2.2.1-5.

Tab. 2.2.1-6: Important export items of Azerbaijan foreign trade

[in tons]

Type of goods	1994	1995
petrochemical products	1,819,108	2,190,481
metallurgical products	348,783	45,073
Bentonit	147,488	68,258
cotton	78,286	75,992
chemical products	74,590	45,427
agricultural products, food	70,873	37,945

Food and agricultural products made up the largest share of Azerbaijan imports in 1995 (for detailed data compare Annex 2.2.1-6).

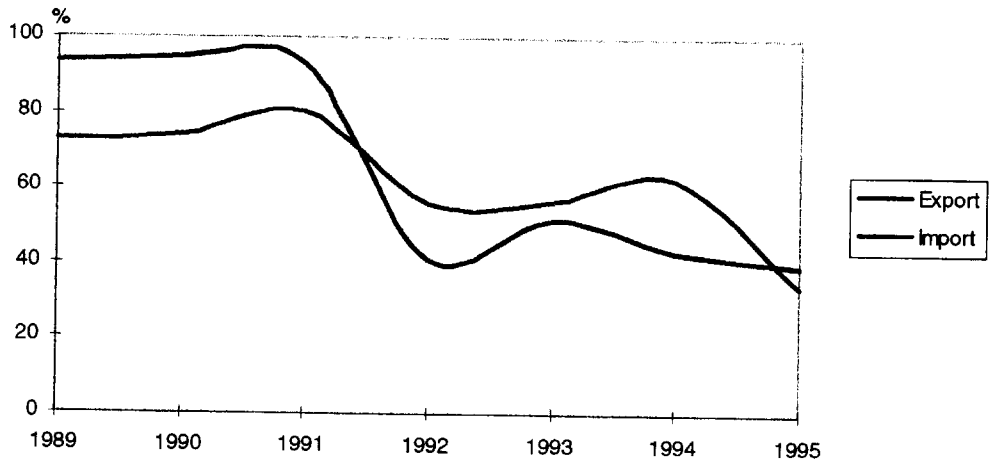
Tab. 2.2.1-7: Main import items of Azerbaijan foreign trade

[in tons]

Type of goods	1994	1995
food	93,535	207,874
fruit, vegetables, potatoes	119,304	83,824
cereals	291,993	112,553
flour	248,800	69,891
sugar	46,495	104,186
crude oil	852,567	61,936
building materials	9,766	153,049
cement	83,007	91,295
metallurgical products	334,432	55,772

A new orientation of the Azerbaijan foreign trade started with the beginning of the '90s. The geographical structure of the exports and imports has changed radically over the past few years. The development is characterised by a sharp drop in the share of the countries of the former Soviet Union. Whereas the share of those countries in the export of 1990 still made up 94.9 per cent and in the import 73.8 per cent, it dropped to 39.6 per cent in export and 34.2 per cent in import, in 1995. (comp. Annex 2.2.1-1).

Fig. 2.2.1-8: CIS share in Azerbaijan foreign trade
[in % of total value]



Iran and Turkey have taken on a growing importance for Azerbaijan foreign trade in the last few years. The share of Iran in Azerbaijan's exports was just under 30 per cent in 1995 and in the case of imports the share stood at 12 per cent. Turkey achieved a 21 per cent share in Azerbaijan's imports in 1995.

Fig. 2.2.1-9: Main exports of Azerbaijan 1995

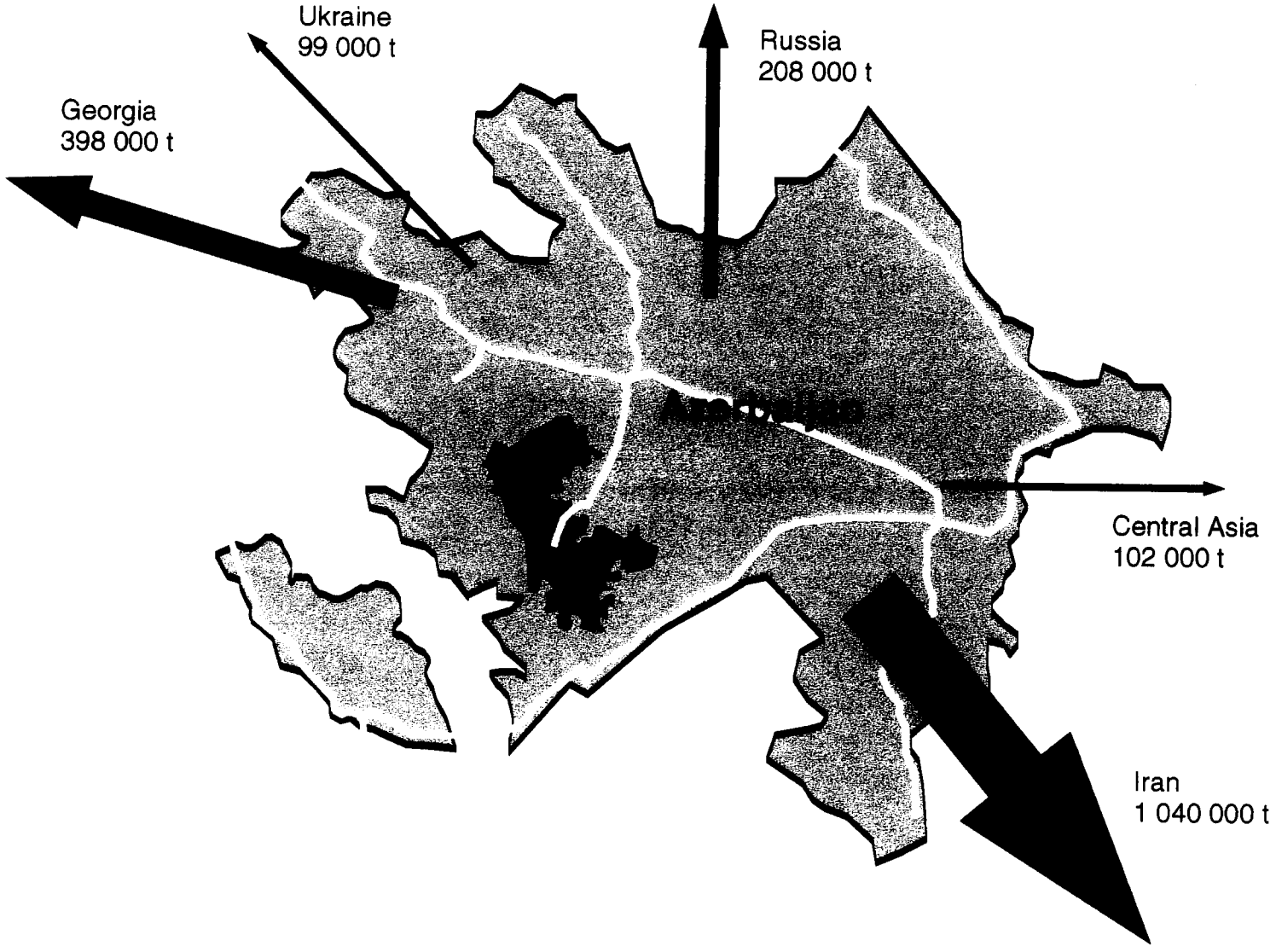
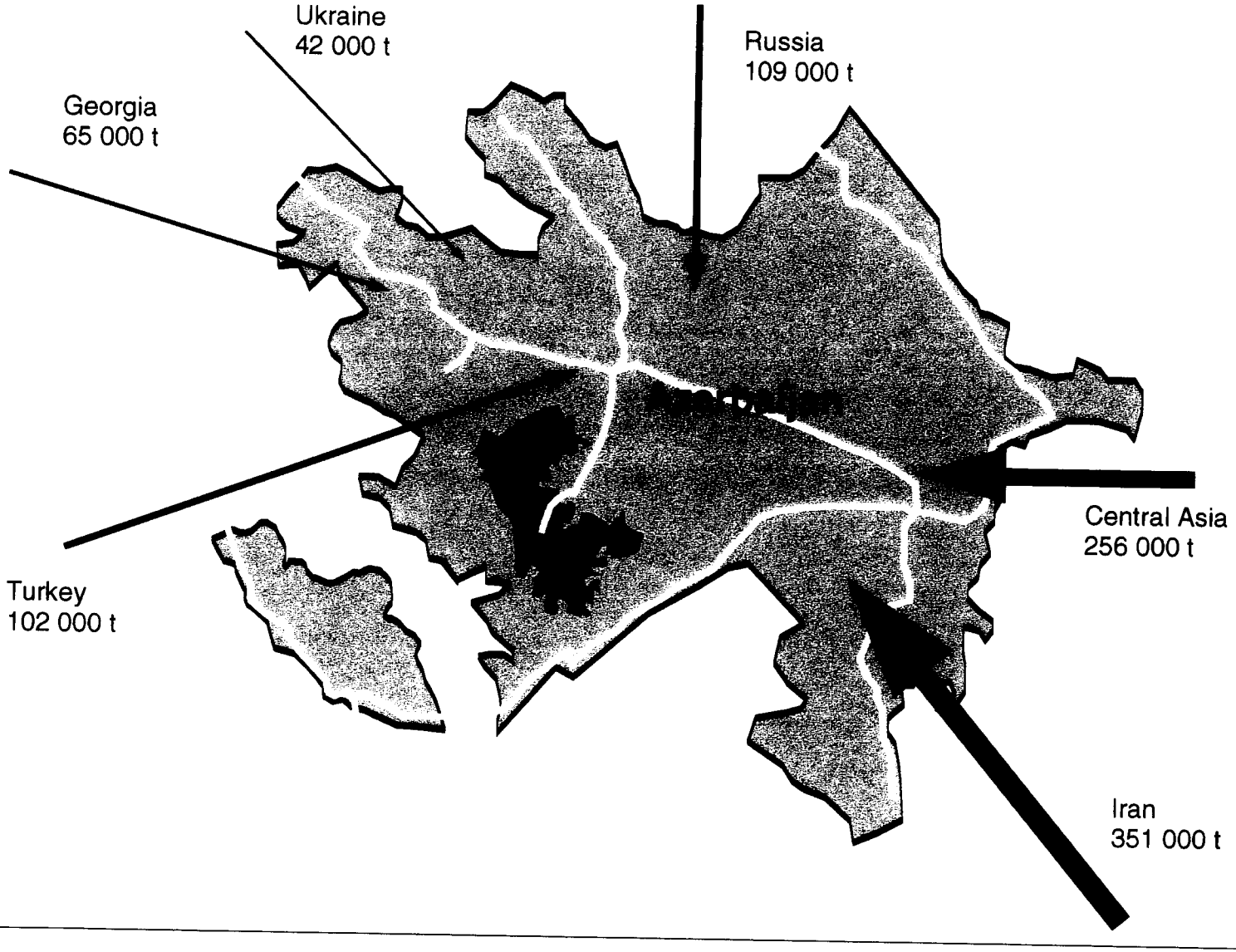


Fig. 2.2.1-10: Main imports of Azerbaijan 1995



Looking at the geographical structure of foreign trade one should also consider the quantities exported and imported. Looking at it from this angle, the current dominating role of Iran, with a share of more than 40 per cent of the export and about 30 per cent on the import (1995), becomes especially clear. The geographical structure of the imports and exports is depicted in Figures 2.2.1-9 and 2.2.1-10. Annex 2.2.1-1 contains a detailed overview.

2.2.1.4.2 Georgia

Foreign trade played an important role in the Georgian economy. In 1990, the imports of the country amounted to 41 per cent of the GDP, and the exports corresponded with 46 per cent.
Georgia was highly dependent on exchange relations with the other republics, within the economic system of the former Soviet Union.
The largest part of the raw materials and semi-finished products for further processing were imported. And the countries of the former Soviet Union were the main market for the products of the relatively highly specialised national industry and agriculture. Thus, the effects of the collapse of the economic, trade and payment relations within the former Soviet Union were especially negative for Georgia.
At the moment, the share of CIS countries in Georgian foreign trade is still relatively high. In 1992, the CIS still had a share of 96.3 per cent of Georgian exports and it was 96.8 per cent in the case of imports (comp. Annex 2.2.1-2).
In 1995, the CIS share in the foreign trade turnover was still more than 50 per cent. At the moment, Russia and Turkmenistan represent the main trade partners of Georgia, followed by Turkey, Bulgaria and Romania, all three bordering on the Black Sea. Figures 2.2.1-11 and 2.2.1-12 show the main trade flows from and to Georgia.

Those branches of industry producing on the basis of domestic raw materials, such as non-ferrous and ferrous metallurgy, the chemical and the petrochemical industries, the building materials industry as well as agriculture, play a vital role in Georgia's exports. Imports focus much on fuels as well as agricultural products and food (comp. Annex 2.2.1-4). The goods structure of Georgian foreign trade is depicted in figure 2.2.1-13.

Fig. 2.2.1-11: Main export partners of Georgia in 1995

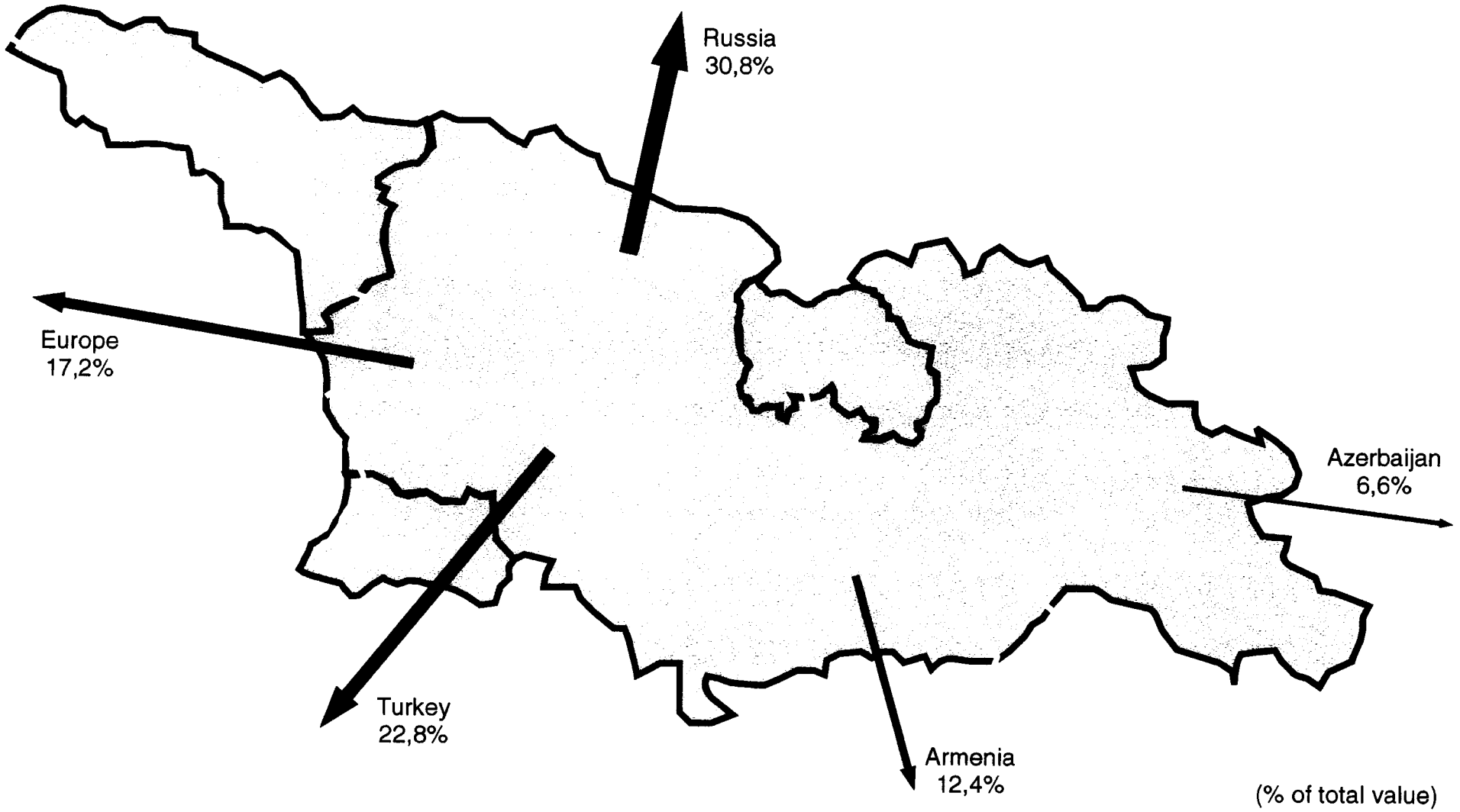
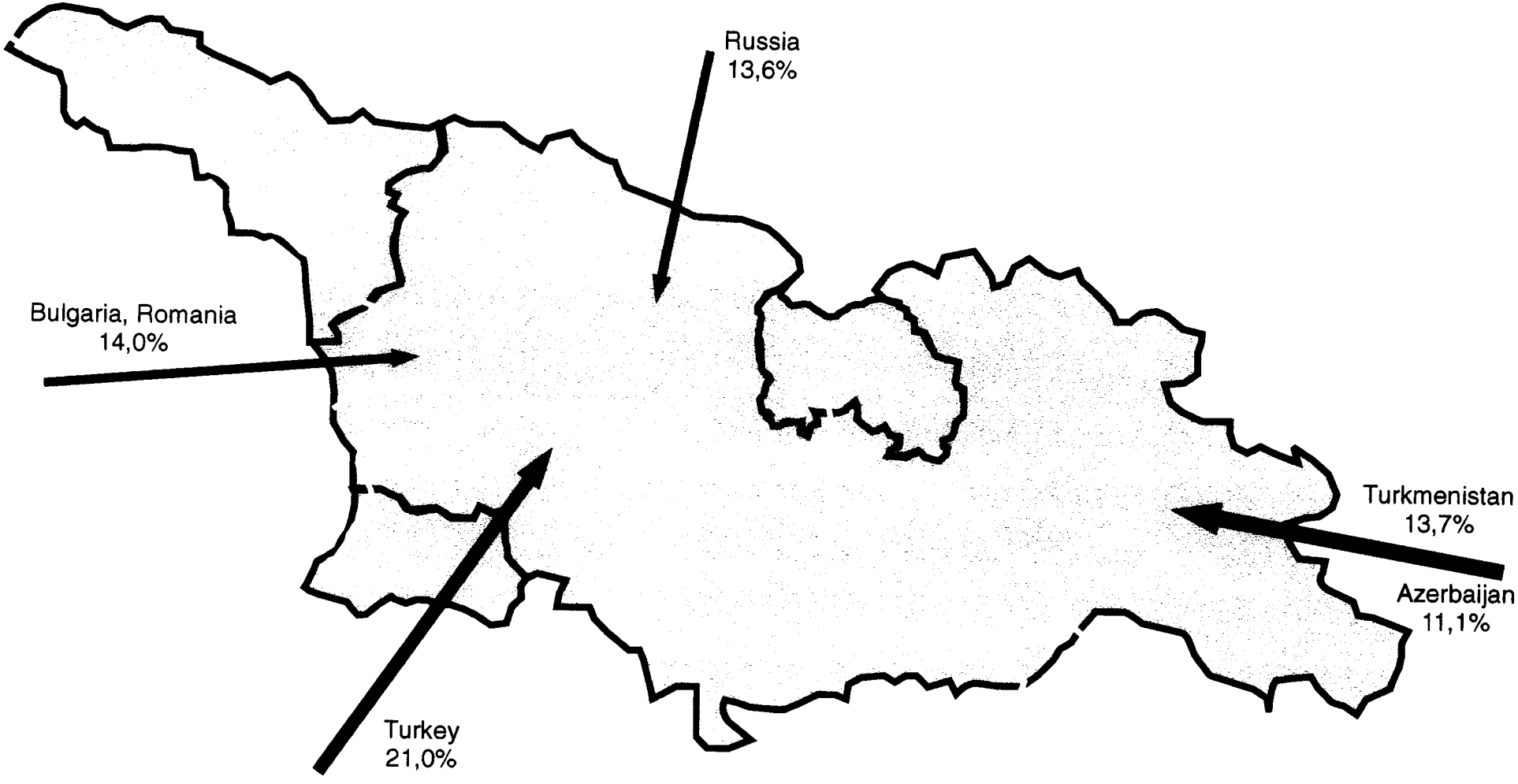
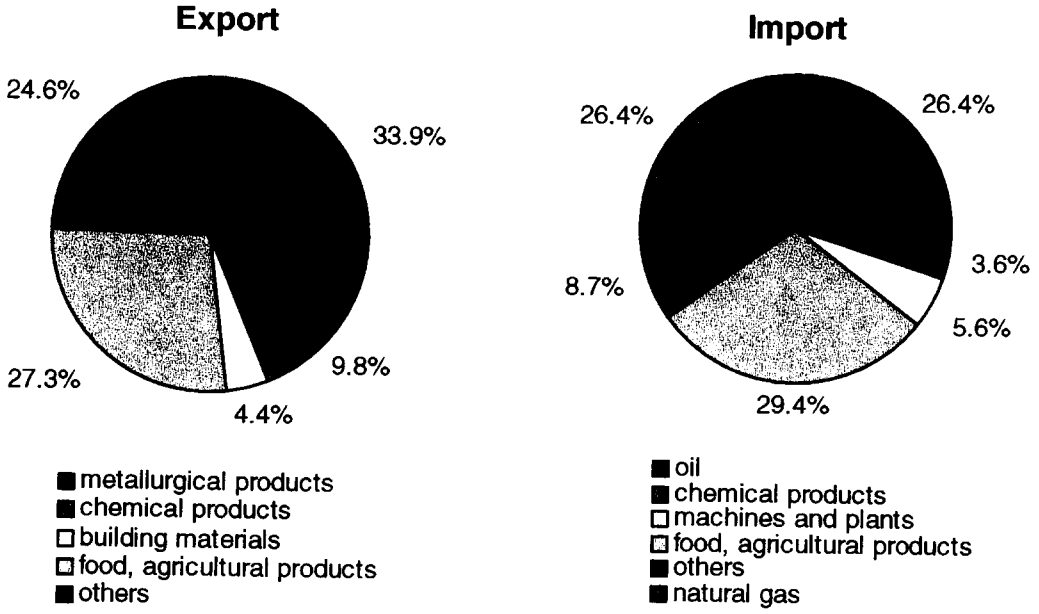


Fig. 2.2.1-12: Main import partners of Georgia in 1995



(% of total value)

Fig. 2.2.1-13: Goods structure of Georgian foreign trade, 1995
(in % of total value)



The bilateral exchange of goods between Azerbaijan and Georgia has special significance for the rail traffic in the investigated corridor of Baku - Tbilisi - Poti/Batumi. The most important types of goods of the mutual imports and exports are listed in Annex 2.2.1-7. The share of petrochemical products in the export of Azerbaijan stood at 80 per cent (based on volume) in 1995. Nitrogen fertiliser makes up the main part of Georgian exports (approx. 32 per cent), metallurgical products rank second (approx. 26 per cent) and then come mineral building materials (approx. 18 per cent).

2.2.1.4.3 Foreign trade of Central Asian republics

Foreign trade with the Central Asian republics of the former Soviet Union represents an important potential for transit transports on the Caucasian Railways. Uzbekistan and Turkmenistan are the most important dispatch and recipient countries in this region. Therefore the development of foreign trade of this two countries is analysed more detailed in the following.

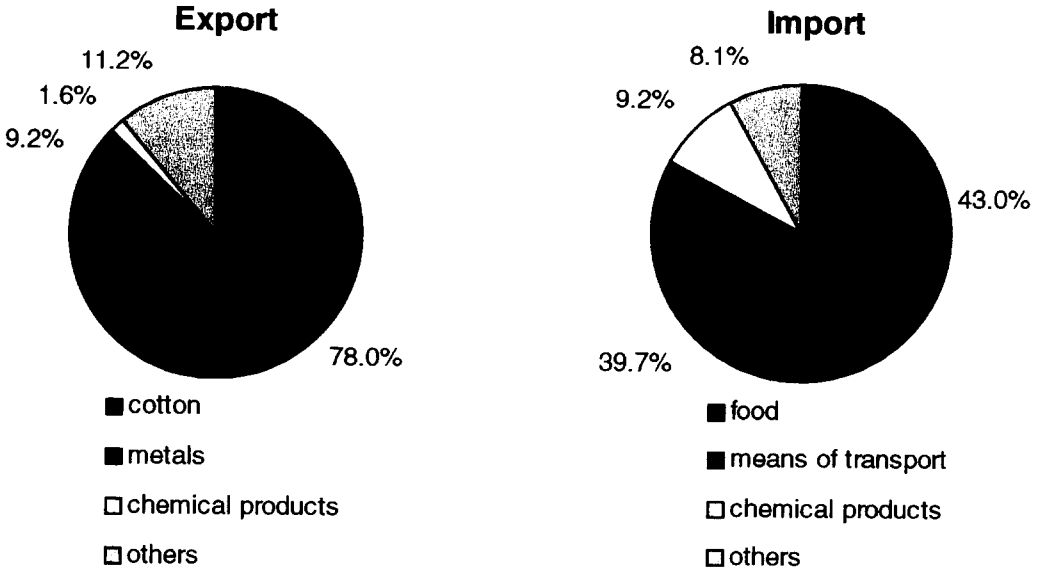
A geographical re-orientation of the foreign trade relations has also taken place in the Central Asian countries over the past years. The foreign trade turnover of ***Uzbekistan*** with countries outside the CIS has increased steadily in the last few years. In 1994, exports rose by 14 per cent and imports by 19 per cent, as compared to the previous year. In the first six months of 1995, the growth of exports was about 50 per cent and of imports it was 39 per cent. The proportion of European partners in the exchange of goods with Uzbekistan has risen sharply. Europe accounted for 72.9 % of Uzbek exports and 67.1 % of the imports in 1994.

Turkey is another trade partner of growing importance.

The goods structure of Uzbek exports is still very one-sided at the moment. The share of cotton was 78 per cent of the total exports of the country in the first half of 1995, non-ferrous and ferrous metals made up 9.2 per cent and chemical products 1.6 per cent.

The share of food in imports was 43 per cent, 40 per cent of all imports were means of transport and 9 per cent chemical products.

Fig. 2.2.1-14: Commodity structure of Uzbek foreign trade in the first six months of 1995 (in % of total value)



Due to the rich deposits, raw materials will continue to play an important role in the Uzbek export business. Up to the year 2000, for instance, the country's oil production is to be increased to 10 million tons per year. Uzbekistan is among the 10 largest natural gas producers in the world. Raw materials for the building material industry constitute a further important export potential.

However, Uzbekistan is undertaking efforts to increase the share of processed products in the exports, too. There are chances to accomplish this aim especially in the light industry. At the moment, only some 15 per cent of the cotton grown in the country is also processed there, there are plans to rise this share to at least 25 per cent up to the year 2000.

In 1996, Uzbekistan exported a total of 3.451 million tons of goods. The decisive share had mineral products with 1.121 million tons (32.5 %), products of vegetable origin with 0.462 million tons (13.4 %) and textiles and textile products with 0.896 million tons (26,0 %). A large part of the exports (1.340 million tons = 38.8 %) went to the other Central Asian republics.

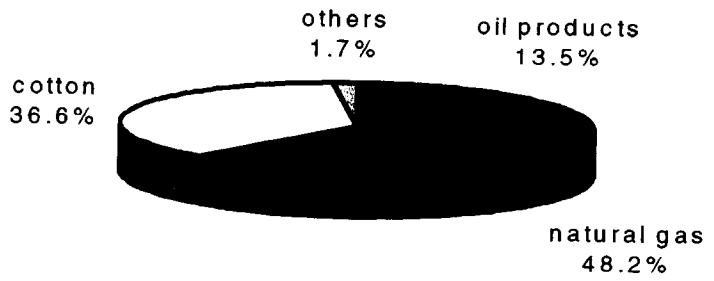
Uzbekistan's imports in 1996 totalled 6.465 million tons. The most important items were: products of vegetable origin (1.964 million. t = 30.4 %) and mineral products

(2.483 million tons = 38.4 %). 46.1 % of all imports came from the other Central Asian republics.

The European countries play a growing role also in the foreign trade of ***Turkmenistan***. Their share in the exports of the country was 63.9 per cent in 1994, and 55.4 per cent in imports. Turkey is a main trading partner for Turkmenistan, too. Its share in the exports of the country was 21 per cent over the above quoted period, and Turkey had a share of 11.6 per cent in Turkmenistan's imports.

Similarly to Uzbekistan, the exports of Turkmenistan are determined largely by unprocessed raw materials:

Fig. 2.2.1-15: Commodity structure of Turkmenistan's exports, 1993 (in % of total value)



In 1995, Turkmenistan exported a total of 3.647 million tons of goods, 28 % of which went into the other Central Asian republics. With 3.111 million tons, mineral products had a share of 85.3 % in the overall export. In the same year 2.173 million tons were imported. 18.7 % of this quantity were mineral products, 18.7 % chemical products, and 18.2 % products of vegetable origin. 52.5 % of the imports came from the other Central Asian republics.

Compared to these two countries, the foreign trade volumes of Kyrghyzstan and Tadjikistan were relatively small. In 1995 Kyrghyzstan exported a total of 0.765 million tons, 49 % of which into the other Central Asian republics. Imports amounted to 1.704 million tons, and 68 % of all deliveries came from the other Central Asian republics. Tadjikistan exported in 1995 a total of 0.562 million tons, and 1.386 million tons were imported, 51 % of which from the other Central Asian republics.

2.2.1.5 Present volumes of railway freight transport

For analysing the present transport volumes in railway traffic and for preparing the traffic forecast the flows of goods were classified as follows:

- domestic traffic
- exports
- imports
- transit

The determining factor for this classification was the existing statistic material to start from. The statistical data made available by the three railway administrations could be unified according to this scheme both for the entire network of the individual railways and , in the first place for the main transport corridors.

In the following, *freight dispatch* means the overall quantity of goods (loaded /forwarded tons) being forwarded in the individual period on the network of the corresponding railway.

Domestic traffic are those transports for which both dispatching station and receiving station are located inside the network of the individual railway administration.

According to this definition, *freight dispatch* is the sum total of domestic traffic and exports.

Contrary to the customary definition, *transit* here below in specific cases, especially as refers to transports on select corridors, means only those transports which mean transit to *both* railway administrations. These cases will be especially earmarked wherever they appear.

2.2.1.5.1 Total railway freight traffic

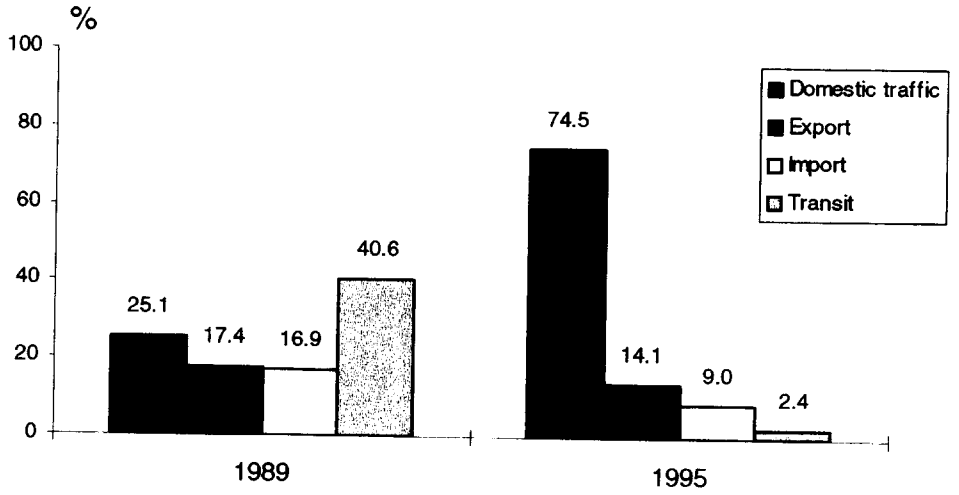
Azerbaijan

The volume of Azerbaijan's rail transport dropped from 91.4 million tons in 1989 to a mere 9.1 million tons in 1995. This corresponds with a decrease to 9.9 per cent. The transport performance, during the same period, dropped from 41.9 billion tkm to 2.4 billion tkm, i.e. to a mere 5.8 per cent. This even more significant reduction in the transport performance is due to a decisive shortening of the average transport distances. The average transport distance of 458 km in 1989 decreased to 265 km in 1995, because the main transport corridors to the north (Yalama - Russia) as well as to the south (Nakhichevan - Dshulfa - Iran) were closed down.

The transport flows of the Azerbaijan Railways have changed markedly, due to the political development in the region, above all, but also because of the collapse of the economic and trade system of the former Soviet Union. For instance, transit transports in 1989 still constituted a share of 40.6 per cent of the entire transport volume.

In 1995, it only made up a proportion of 2.4 per cent. The share of exports and imports, too, was reduced drastically. This led to the situation that the domestic transport had a share of 74.5 per cent in 1995 as compared to 25.1 per cent in 1989, even though the absolute transport volume of domestic transports went back by nearly 70 per cent during this period (comp. Annex 2.2.1-9).

Fig. 2.2.1-16: Structure of Azerbaijan's railway transports (transport volume)



Products of the oil processing industry constituted the main part or 76.1 per cent of freight transport of the Azerbaijan Railways in 1995, building materials made up 12.2 per cent.

Tab. 2.2.1-8: Freight transport of Azerbaijan Railways

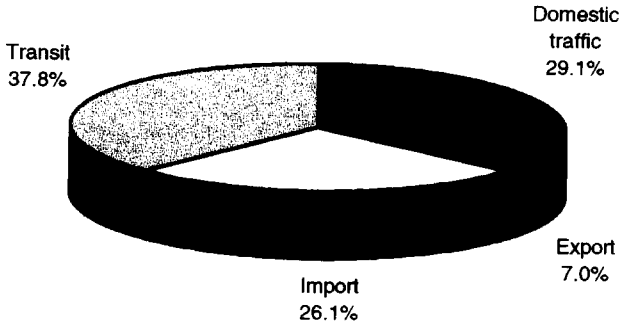
	1989		1995	
	1000 t	%	1000 t	%
Total freight dispatch	39,466	100.0	8,429	100.0
of which:				
oil products	*10,692*	*27.1*	*6,416*	*76.1*
building materials	*13,044*	*33.1*	*1,031*	*12.2*
Exports	15,895		1,277	100.0
of which:				
oil products	...		*1,064*	*83.3*
Imports	15,477		815	
Transit	37,082		219	

The average transportation distance in freight traffic of the Azerbaijan Railways dropped from 458 km in 1989 to 225 km in 1995, which is due, as mentioned above, to the closure of important transit corridors.

Georgia

In Georgia there is a similar development in railway freight transports as compared to Azerbaijan. The entire transport volume dropped from 36.2 million tons in 1988 to 4.7 million tons in 1995, this corresponds with a reduction to 13.0 per cent. The transport performance decreased from 12.6 thousand million tkm in 1988 to only 1.2 thousand million tkm in 1995, i.e. to 9.9 per cent (comp. Annex 2.2.1-10). The share of transit transports of 37.8 per cent in the total volume of transports, in 1995, was relatively high as compared to Azerbaijan. On the other hand, the share of domestic transports was only 29.1 per cent:

Fig. 2.2.1-17: Structure of Georgia's railway transports 1995 (transport volume)



2.2.1.5.2 Railway freight traffic in main corridors

The following corridors, which are of special importance in the network of the three railways, were subject of a detailed investigation:

- Baku - Gyandsha - Tbilisi - Samtredia - Poti / Batumi
- Baku - Nakhichevan / Dshulfa - Iran
- Baku - Nakhichevan - Yerevan
- Baku - Astara - Iran
- Baku - Yalama - Russia
- Tbilisi - Yerevan - Nakhichevan / Dshulfa - Iran
- Tbilisi - Gyumri - Turkey
- Tbilisi - Samtredia - Sukhumi - Russia

The current situation of railway freight traffic in the quoted corridors is described in the following. The goods flows are divided up according to

- domestic traffic
- exports
- imports
- transit.

Unfortunately there was not complete statistical data available for the individual transport corridors so that in many cases own calculations and assumptions were used.

Baku - Tbilisi - Poti / Batumi

The Trans-Caucasian Railway line from Baku at the Caspian Sea, via Tbilisi to the Black Sea ports of Poti and Batumi is by far the most important axis for both countries at the moment. The significance of this line has even increased because of the blocking of important international links, due to political tensions in the region (comp. Fig. 2.2.1-1). The Azerbaijan Railways cater for about 90 per cent of the entire transport performance on the Baku - Beyuk Kyassik line. The Georgian Railways conduct about 75 per cent of their transports in the corridor of Tbilisi - Batumi/Poti, at the moment.

In order to assess the future transport potentials on this line as exactly as possible, the transport corridor was divided up into individual main sections first:

- Baku - Gyandsha
- Gyandsha - border of Azerbaijan/Georgia - Tbilisi
- Tbilisi - Batumi
- Tbilisi - Poti

Then, the transport flows on the individual sections of the line were split up into their above mentioned main components.

The current situation resulting for 1995 has been compiled for the East-West direction in Fig. 2.2.1-18 and for the West-East direction in Fig. 2.2.1-19. The detailed figures are contained in Annexes 2.2.1-11 to 2.2.1-14.

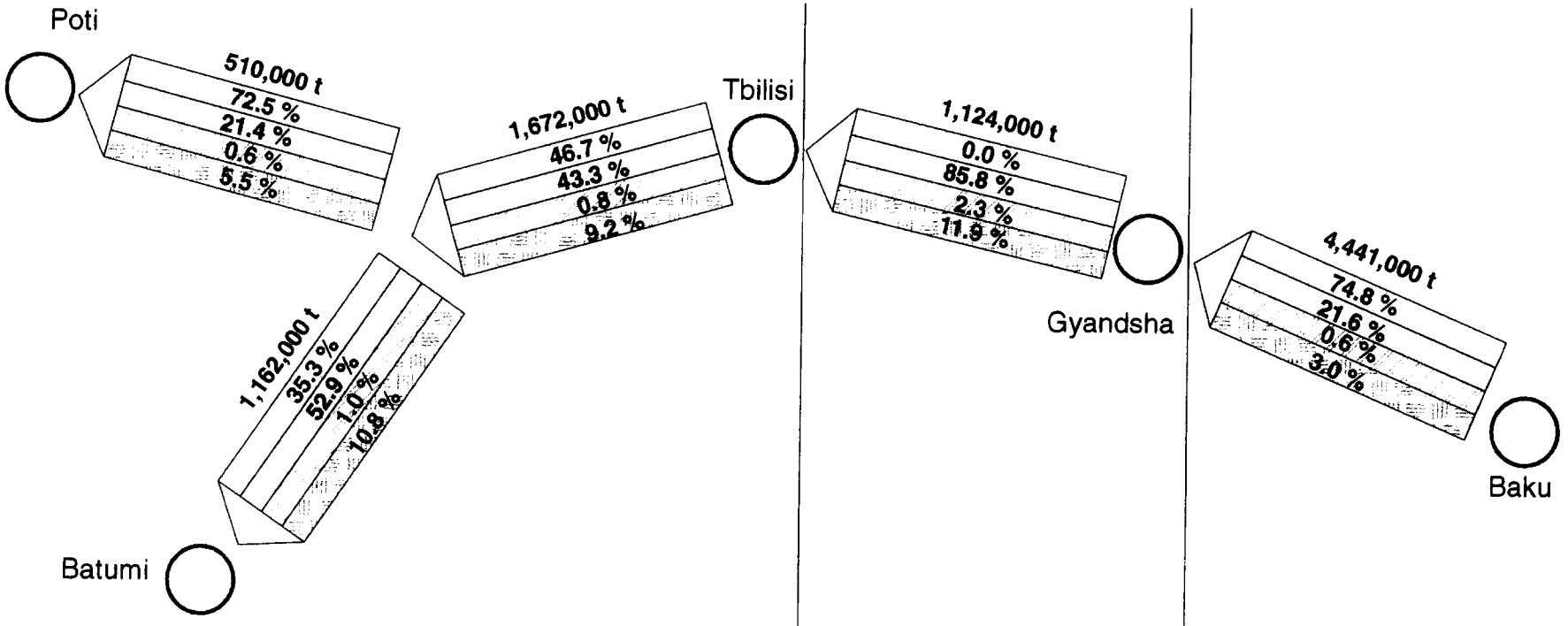
As there was either incomplete or no statistical data for some of the line sections as well as certain parts of the freight flow, often own calculations or assumptions as regards volume, structure and direction of the transports had to be applied. Thus, detailed explanations are given for each of the transport flows in the following:

Domestic traffic:

The transported volumes on the section of Baku - Gyandsha and vice versa were calculated for the domestic traffic of **Azerbaijan** on the basis of existing statistical data on transport performance. The volumes depicted for the entire section represent an average figure. The burden on the respective line sections is contained in Fig. 2.2.1-20.

The domestic traffic of Azerbaijan quoted, in Figures 2.2.1-18 and 2.2.1-19 respectively, includes Azerbaijan imports (in East-West direction) and exports (in West-East direction), whose share in the total volume is insignificant, however.

Fig. 2.2.1-18: West-bound traffic 1995



Tbilisi-Poti	Tbilisi-Batumi	Gyandsha-Tbilisi	Baku-Gyandsha	
370,000 t [2]	410,000 t [2]	0 t	3,329,000 t [1]	Domestic traffic
109,000 t	615,000 t	964,000 t	952,000 t	Exports Azerbaijan
3,000 t	11,000 t	26,000 t	26,000 t	Imports Georgia
28,000 t	126,000 t	134,000 t	134,000 t	Transit

[1] incl. Azeri imports

[2] incl. Georgian exports

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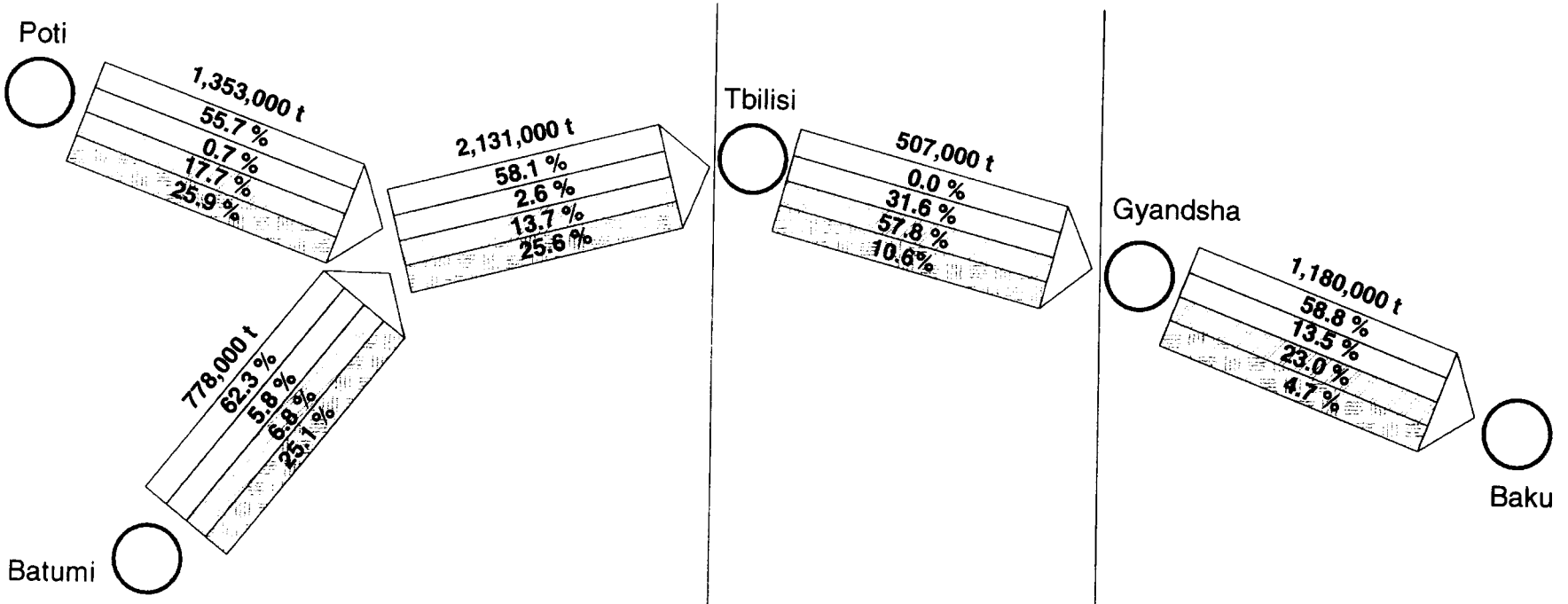
Fig. 2.2.1-19: East-bound traffic 1995



Poti-Tbilisii	Batumi-Tbilisi	Tbilisi-Gyandsha	Gyandsha-Baku	
753,000 t [1]	485,000 t [1]	0 t	706,000 t [2]	Domestic traffic
10,000 t	45,000 t	160,000 t	155,000 t	Exports Georgia
240,000 t	53,000 t	293,000 t	265,000 t	Imports Azerbaijan
350,000 t	195,000 t	54,000 t	54,000 t	Transit

[1] incl. Georgian imports

[2] incl. Azeri exports

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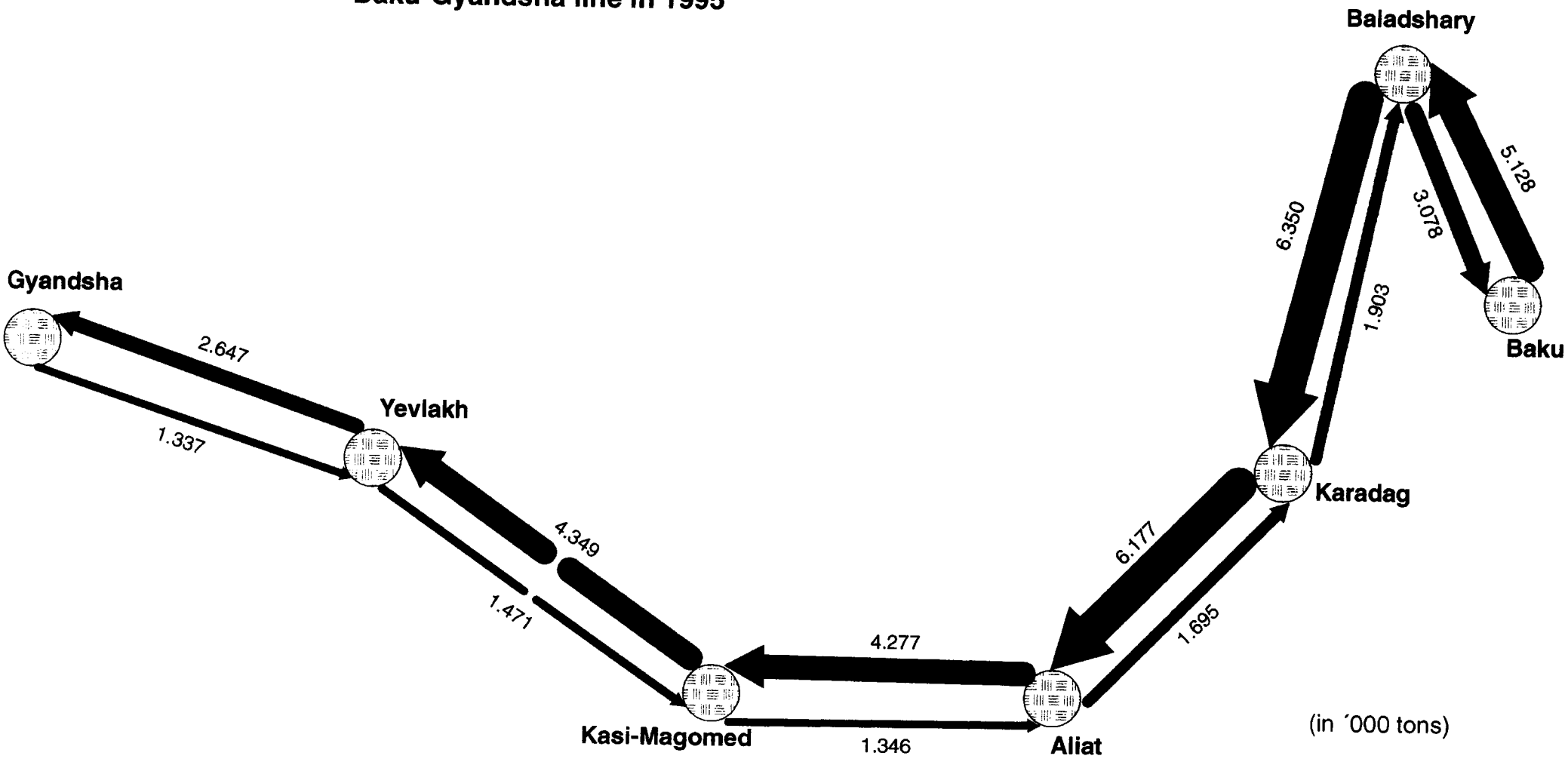
Fig. 2.2.1-20: Transport volume on the Baku-Gyandsha line in 1995



The strong disparity of the freight flows in domestic traffic is striking. The transports in the western direction are more than four-fold that of the transports in the opposite direction.

Unfortunately, there is no statistical data on the structure of goods being transported in domestic traffic on the quoted section of the line. However, one may assume that it was mainly petrochemical products which were transported in the western direction (compare section 2.2.1.3.1), whereas in the eastern direction it was above all mineral building materials and other raw materials which were transported from the Gyandsha and Yevlakh area. Domestic traffic on the section Gyandsha - border was neglected due to its insignificant volume. Unfortunately, there was no statistical data on domestic traffic in **Georgia,** relating to the line. It was assumed that some 75 per cent of the 1.37 million tons total transport volume of domestic traffic were forwarded on the Tbilisi - Batumi/Poti section. The volume resulting from this assumption was allocated, according to their significance, to the individual recipient and dispatch areas on the Tbilisi - Poti and Tbilisi - Batumi sections and the respective direction (East-West / West-East). Domestic traffic in the East-West direction contains Georgian exports, and the transports in the opposite direction Georgian imports.

Exports and imports of Azerbaijan and Georgia

For clarification of the terms, one has to say that the Azerbaijan exports in the East-West direction also contain the exports to Georgia, Georgian imports, on the other hand, are imports from third countries in transit through Azerbaijan.
In the opposite direction, the Georgian exports contain the exports of the country to Azerbaijan. Azerbaijan imports are those from third countries in transit via the ports of Poti and Batumi. According to existing statistics of the Azerbaijan Railways, the cross-border railway traffic (without transits) via the Beyuk-Kyassik border crossing point in 1995 was as follows:

Tab. 2.2.1-9: Cross-border railway traffic between Azerbaijan and Georgia

Type of goods	Azerbaijan Export		Azerbaijan Import	
	tons	%	tons	%
Total	*963,801*	*100.0*	*452,813*	*100.0*
petrochemical products	941,958	97.7	5,106	1.1
coal, coke				
ore			62,125	13.7
ferrous metals			17,290	3.8
timber				
mineral building materials	1,499	0.2	12,698	2.8
cement	65	0.0	491	0.1
mineral fertiliser			18,693	4.1
cereals			315,335	69.9
others	20,279	2.1	21,075	4.7

Note: Data provided by Azerbaijan Railways for 1995, without transits, but including Azerbaijan exports and imports via Black Sea ports.

Unfortunately, the statistics do not show the destination countries for Azerbaijan exports nor the countries of origin for the imports. However, one may assume that some 400,000 tons of the exports were destined for Georgia and approx. 65,000 tons of the imports came from Georgia (comp. Annex 2.2.1-7). The remaining volume was foreign trade traffic of Azerbaijan, transported in transit through Georgia.

Table 2.2.1-9 shows clearly that the Azerbaijan exports by rail were absolutely dominated by the item of petrochemical products in 1995. In the imports, two thirds were made up by cereals.

In 1995, some 75 per cent of the Azerbaijan exports transported by rail went via the Beyuk-Kyassik border crossing point. Even though there is no exact statistical data, one may assume that the Azerbaijan exports were split between the ports of Batumi and Poti at a ratio of 85:15. This is deduced from the structure of the goods exported by Azerbaijan (Batumi as the main oil port and refinery location).
56 % of Azerbaijan imports in rail traffic came into the country via the Beyuk-Kyassik border crossing point. Due to the structure of the goods, one may deduce that the imports via the Black Sea ports were split between Poti and Batumi at a ratio 80:20 (Poti as the most important port for general cargo and cereals).

Due to the geographical structure of Georgian foreign trade, one may assume that some 50 per cent of the exports and some 30 per cent of Georgia's imports (in rail traffic) was conducted through the Beyuk-Kyassik border crossing point.

Transit traffic

Transit traffic in this case means transports, which run through *both* countries in transit, thus they do not contain foreign trade transports of either country. According to statistical data of the Azerbaijan Railways, the transit transports via the Beyuk-Kyassik border crossing point in 1995, were composed as follows:

Tab. 2.2.1-10: Transit transports via Beyuk-Kyassik border crossing point, 1995

Type of goods	East-West direction		West-East direction	
	tons	%	tons	%
total	*159,835*	*100.0*	*54,185*	*100.0*
petrochemical products	135,862	85.0	381	0.7
coal, coke	915	0.6	-	-
ore	65	0.0	1,686	3.1
ferrous metals	3,588	2.3	25,031	46.2
timber	963	0.6	105	0.2
mineral building materials	4,542	2.8	1,441	2.6
cement	3,651	2.3	-	-
mineral fertiliser	-	-	-	-
cereals	3,804	2.4	420	0.8
others	6,445	4.0	25,121	46.4

The transit transports on the Azerbaijan side are distributed as follows:

Tab. 2.2.1-11: Origin/destination of transit transports via Beyuk-Kyassik

Origin/Destination	East-West direction		West-East direction	
	tons	%	tons	%
total	**159,835**		**54,185**	
Baku - ferry	136,541	85.4	13,814	25.5
Yalama - (Russia)	23,294	14.6	36,785	67.9
Astara - (Iran)			3,588	6.6

There are no exact statistical details for the transit flows on the Georgian side. Thus, the following own assessments were drawn up:

The westbound transit transports are split between the ports of Batumi and Poti at a ratio of 80:20, based on the structure of the type of goods. As of Tbilisi, there is a smaller volume from Armenia and a similarly small proportion branches from Tbilisi in the direction of Armenia.
The eastbound transit transports (including those for Armenia) are also channelled through the ports of Poti and Batumi at a ratio of 65:35, based on the structure of the type of goods. The share of the freight destined for Armenia currently stands at 90 per cent of the entire eastbound transit traffic through Georgia.

The following overview makes clear the strong imbalance of freight flows on the individual line sections (total transport volume in 1995 in '000 tons):

	Westbound	Eastbound
Baku - Gyandsha	4,441	1,180
Gyandsha - Tbilisi	1,124	507
Tbilisi - Poti	510	1,353
Tbilisi - Batumi	1,162	778

Baku - Nakhichevan / Dshulfa - Iran

Traffic on this line has been completely ceased at the moment due to the conflict of Nagorno-Karabakh.

In the past, this line was an important transit corridor for rail transports from and to Iran. Exports from the former Soviet Union as well as the Scandinavian countries (wood, paper) to Iran mainly ran via Dshulfa. This route was also important for rail transports from and to Western Europe and was at times used more frequently than the transit route through Turkey.

In 1989, some 2.2 million tons of transit goods were transported via Dshulfa to Iran, and it was 0.1 million tons in the other direction.

Due to differing gauges of the railways in Iran and the former Soviet Union, the goods had to be transhipped in Dshulfa.

Baku - Nakhichevan - Yerevan

In the past, this line used to be of great significance for the exports and imports of Armenia. Eighty per cent of the country's imports and exports were handled in transit through Azerbaijan. In 1989, 61 per cent of all Armenian imports were channelled through Nakhichevan in rail transport.

According to details provided by the Azerbaijan Railways, the following amounts of freight were transported on this line during the period of 1989 to 1991 (in '000 t)

	1989	**1990**	**1991**
to Armenia	10,112	8,107	5,715
out of Armenia	3,138	1,629	497

Baku - Astara

This line is of subordinated significance for railway traffic. It is of interest, above all, for transports to and from Iran. However, the rail track only reaches Astara (Azerbaijan). Transports from and to Iran are continued by road from that point.

The transport volumes are insignificant at the moment. In 1993, 109 thousand tons were transported in the direction to Iran and 16 thousand tons in the opposite direction. After that the transport volume decreased further.

Baku - Yalama

In the past, this was by far the most heavily used railway line. Nearly the entire rail freight traffic between Azerbaijan, Georgia, Armenia and Russia as well as the other republics of the former Soviet Union was handled via this corridor. Over the past few years, the traffic has been closed down or limited severely due to the situation in Chechnya. The following goods volumes were transported (in '000 tons):

	1989	**1990**	**1991**	**1995**
Northbound	17,770	14,981	13,359	270
Southbound	40,025	37,271	8,723	181

Under normal political conditions in the region, this line is the shortest direct rail link of the Central Asian republics (except for Kazakhstan) to Russia and the Ukraine. It

is also the preferred corridor for direct rail transports from Northern and Central Europe to these countries of Central Asia. Transports from and to Central Asia via sea ports will rarely use this line (to Novorossijsk on the Black Sea coast), as the Baku - Poti / Batumi connection is considerably shorter:

Tashkent	-	Poti	3,094 km
Tashkent	-	Novorossijsk	3,512 km
Ashkhabad	-	Poti	1,810 km
Ashkhabad	-	Novorossijsk	2,228 km

Tbilisi - Masis / (Yerevan) - Dshulfa - Iran

This line, along which there is no international rail traffic in the direction to Iran at the moment, was of little importance for transit in the past. Transits from and to Iran via Dshulfa were handled more or less exclusively via the line through Azerbaijan as described above. The most important reason for this was that the further connection in transit through Georgia to Russia - a single track line to a large extent - was mainly used for passenger traffic in the past.
The exchange of goods between Armenia / Georgia and Iran was completely insignificant during the times of the Soviet Union.

Tbilisi - Gyumri - Turkey

This line, too, which represents the only direct rail link between Turkey and the CIS states, was used for international freight traffic only to a limited extent in the past. The main reason for this was the insignificant volume of trade between Turkey and the adjoining regions of the former Soviet Union.

In 1992, international traffic between Armenia and Turkey was ceased completely.

Competitive rail transport corridors

Competitive rail connections, which do not cross the territories of Armenia, Azerbaijan or Georgia, mostly relate to transports from and to Central Asia. The following corridors may be regarded, above all, as competitive connections between Europe and Central Asia or the Far East:

1) Western, Central, Northern Europe - Russia - Kazakhstan - Uzbekistan / Turkmenistan / Far East

2) Western, Central, Northern Europe - Russia - Far East (Transsib)

3) Western, Central, Southern and South Eastern Europe - Turkey - Iran - Turkmenistan

It is difficult to present a general assessment of the advantages and disadvantages of the individual corridors, as regards distances, transport times, tariffs etc. The concrete economic advantages and disadvantages of the individual corridors depend decisively on the respective origin or destination, on the type of goods to be transported, demands on transport time and quality and so on.

Furthermore, today and in the future, decisions on the transport route are and will be influenced strongly by political and trade policy aspects, and customs issues play an important role, too. The tariffs to be applied will also be significant in future. Especially in this area, a possible development is difficult to predict, as all the countries of the region will try to participate in the quickly developing transit market by employing a respective tariff policy. Even at present it is evident that, despite existing agreements between the railways concerned, there is no joint, co-ordinated tariff policy and will hardly be achievable in future.

A comparative analysis of the individual corridors which will take into account distances, transport times and, in the first place, transport costs, is only possible for concrete types of goods with clearly defined dispatching and receiving places. Such a detailed analysis, however, was not required for preparing the traffic forecast according to the methodology described above.

Thus, certain origin-destination relations and catchment areas had been determined, for which the one or the other transit route is predestined. The significance of the competing main corridors for selected relations is assessed in the following, assuming a normal political situation and thus unrestricted usability of the respective lines. This evaluation of the individual corridors together with the evaluation of the competitive modes of transport in the first place served to estimate which shares the individual transit routes will have in the future foreign trade flows of the Central Asian and Far Eastern countries.

Baku - Tbilisi - Poti / Batumi

- main corridor for exports of Azerbaijan to overseas destinations and imports from overseas
- most favourable sea port link for Azerbaijan, Georgia, Armenia
- advantageous sea port link for Uzbekistan, Turkmenistan Tadjikistan, Kyrghyzstan
- great significance for multi-modal transports to the Caucasus region, Central Asia and Northern Iran

Baku - Yalama - Russia

- main corridor for exports and imports of Azerbaijan to Russia, Ukraine, Belarus, Northern and Central Europe in direct rail traffic
- most favourable transit line from/to Central Asia (via the ferry of Baku - Turkmenbashi) from Northern and Western Europe, Western Russia, Ukraine
- transit line for direct railway traffic between Iran, Armenia, Georgia and Russia, Northern Europe

Europe - Russia - Far East (Transsib)

- advantageous link in direct rail traffic between Europe and the Far East via Russian ports on the Pacific Ocean
- favourable direct rail link between Europe and China, Korea

Europe - Russia - Kazakhstan - Central Asia / Far East

- preferred transport corridor for direct railway traffic between Europe and Northern, Western Kazakhstan
- favourable rail link between Europe, Western Russia, Ukraine and Western Uzbekistan
- possible rail link between Europe and China (via Drushba)

Europe - Turkey - Iran - Turkmenistan

- possible rail connection from Southern, South Eastern Europe to Eastern Turkey, Armenia, Iran
- disadvantages of this line for direct rail transports between Europe and Central Asia are the larger distances and difficult infra-structural conditions (e.g. two ferry crossings across the Bosporus and Lake Van)

Turkmenistan - Iran

- possible access of the countries of Central Asia to the Gulf ports (Bandar Abbas)

2.2.1.5.3 Transportation of main commodities

For the traffic forecast three groups of goods were investigated in detail:
- oil products
- cotton
- containers

The main reason for choosing exactly these groups was their special importance to the present and future transport volumes of the three Caucasian Railways. Different from the methodology described in section 2.2.1.1, special assumptions were made for these groups which will be more detailed in section 2.2.1.6.3. For all other types of goods the forecast was made in accordance with the methodology mentioned above.

Oil products

For the sake of clarity, the production of, trade with and transport of oil products were coherently analysed in section 2.2.1.3.1. Details as to the future transport volumes are given in section 2.2.1.6.3.

Cotton

Cotton is of special importance for transit transports from Central Asia via the lines of the Azerbaijan and Georgian Railways. This group of goods currently is one of the major items in westbound traffic from Central Asia and will keep gaining importance in future.

The Central Asian republics belong to the important cotton producers of the world. Uzbekistan is the fifth-largest producer and the second-largest exporter of cotton in the world.

Production and export of cotton has been steadily decreasing in the Central Asian republics and Azerbaijan over the past few years.

Tab. 2.2.1-12: Production and exports of cotton

(in '000 tons)

	1995/96		1996/97*	
	Production	Exports	Production	Exports
Uzbekistan	1,250	980	1,045	936
Turkmenistan	250	196	131	152
Tadjikistan	120	98	89	87
Kyrghyzstan	22	13	26	13
Azerbaijan	83	65	83	65

* estimate, Source: USDA /FAS

In recent years cotton production has been steadily declining in most growing regions of *Uzbekistan*. Cotton production in the country has declined by about 30 per cent since 1989. Lower producer prices, lack of adequate incentives, and a shortage of inputs and operating capital have contributed to the downward production spiral. Low currency levels had led to shortages of fertilisers, seeds, pesticides, machinery and spare parts. In addition, to solve the problem of adequate food supply, the government has encouraged farmers to diversify their crops and focus also on wheat production. This has led to a gradual shift of approximately 600,000 hectares of cotton area to wheat. The decline in cotton production has inevitably reduced the amount of exportable cotton. Lower cotton exports are also due to lower quality and new export pricing schemes.

The situation is almost the same in *Turkmenistan*. For example, farms have shifted approximately 50,000 hectares of irrigated cotton land to wheat, with at least some of the cotton shifted to more marginal land. In addition, non-payment for deliveries of natural gas to FSU countries has made it difficult for the government to maintain its heavily subsidised state production. Compounding the problem, state farms reportedly are not adequately planting, harvesting and picking cotton. If solutions to these problems are not found, the production decline is likely to have a negative impact on cotton exports in the long run. Turkmenistan has gained a more important role in the world cotton market over recent years, exporting cotton at below world market prices to earn desperately needed foreign exchange. Most of the cotton is sold to markets in East Asia, Southeast Asia, and predominantly Western Europe.

In recent years, *Azerbaijan* has relied on cotton exports in addition to its significant oil and natural gas resources to finance its economic growth. However, since the independence of the country in 1991, cotton area, production, and procurement have steadily declined due to the problems shared by all FSU cotton producing countries. The conflict with Armenia, loss of territory, large numbers of refugees, and the blockade of important transport corridors caused by the situation in Chechnya compound Azerbaijan's problems. Prior to the break-up of the FSU, the country channelled most of its cotton exports to Russia, the Baltic States and Eastern Europe. Recently, Azerbaijan has gained a larger share in the world cotton market by exporting cotton at below world market prices to markets in East and Southeast Asia and Western Europe. Nevertheless, although the government places emphasis on cotton as a strategic commodity, problems leading to the decline in cotton production have resulted in lower exportable supplies.

Containers

Container traffic to the three Caucasus republics has increased considerably in recent years. The largest part of the transported containers was handled by the Black Sea port of Poti. The incoming container traffic via Poti port more than doubled every year since 1994.

Tab. 2.2.1-13: Incoming container traffic via Poti port

	1994		1995		1996	
	TEU		TEU	% to 1994	TEU	% to 1995
Influx total	2,417		4,967	205.5	11,310	227.7
Ø per month	201		414		940	

The container flows from and to the Caucasus and Central Asia currently are extremely uneven. The percentage of loaded containers being transported in the East-West direction at present amounts to a mere 7- 10 per cent of those containers transported in the West-East direction.

The containers arriving via Poti port were distributed to the individual destination regions in 1996 as follows (in per cent):

Georgia	39.8
Azerbaijan	13.8
Armenia	37.4
Russia	6.9
Central Asia	2.1

The share of the railways in transporting the containers from the port of Poti differs very much depending on the destination. Some 20 per cent of the containers arriving in Poti port for Azerbaijan were transported by rail from there in 1996. As regards transport to Armenia, the railways' share was about 40 per cent.

Some 1,640 loaded containers (TEU) were transported in the relation of Poti - Baku, in 1996, 340 of which were taken over by the railways. Altogether 4,230 TEU went from Poti to Armenia in 1996, and the railways transported 1,582 of them.

The freight reception in containers of the Azerbaijan Railways amounted to a total of 389 TEU in 1996, and in dispatch the figure stood at 86 loaded TEU (22 per cent of the amount received).

2.2.1.5.4 Cargo flows through ports of Batumi, Poti, Baku

The current situation as well as the development prospects for the ports of Poti and Batumi have been dealt with in great detail already within the framework of other international projects. Respective TRACECA projects are being processed currently on Baku port and the Baku - Turkmenbashi ferry link. That is the reason why a detailed investigation on this subject area is not included in the current project.

Cargo flows to and from the mentioned ports are dealt with only to such an extent as they are relevant to railway traffic.

The following cargo flows from and to sea or ferry ports result from the forecast transport volumes:

Tab. 2.2.1-14: Transports from and to sea ports in railway traffic up to the year 2015

(in '000 t)

	2000		2010		2015	
	opt.	pess.	opt.	pess.	opt.	pess.
Poti						
outgoing traffic	1,785	1,206	2,140	1,509	2,325	1,775
incoming traffic	1,221	1,083	1,612	1,379	1,918	1,660
Batumi						
outgoing traffic	4,595	1,474	7,866	3,309	8,646	3,914
incoming traffic	645	473	825	585	951	695
Baku						
outgoing traffic	273	125	402	387	554	477
incoming traffic	1,605	1,352	2,013	1,659	2,500	1,875

2.2.1.5.5 Competitive transport modes

Road transport

When preparing the traffic forecast according to the methodology described above, annual rates of increase were determined for the individual groups of goods. Possible modifications in the modal split had to be taken into account when determining these percentage rates. In order to assess the future role especially road traffic will play both for individual groups of goods, and for individual transport relations, a detailed analysis of the current situation in all republics was made.

Unfortunately, the data basis on the initial situation in road traffic is very fragmentary in all the countries. The statistical details on road traffic do not contain anything on the private sector. And the data on road freight traffic of the state sector, are not always very reliable either, as the statistics of the three countries are undergoing a restructuring process at the moment and data registration is incomplete.

Azerbaijan

The cargo volume of 153.1 million tons transported by road traffic in Azerbaijan in 1990 dropped to 12.6 million tons in 1995, i.e. down to 8 per cent. The share of road transport in the entire goods traffic of the country (transport volume) was 69.6 per cent in 1990 and by 1994 it had decreased to a mere 38.4 per cent.

Tab. 2.2.1-15: Road freight transport in Azerbaijan

	1990	1994	1995
Transport volume ('000,000 t):			
Total	153.1	19.4	12.6
of which long-haul	2.6	0.8	0.6
Transport performance ('000,000 tkm):			
Total	3287.1	569.0	388.5
of which long-haul	319.7	120.7	79.8

In 1995, there were 100 state-run transport companies conducting freight transports in Azerbaijan. Their vehicle stock comprised 11,900 trucks with an average age of 9 years.

The following table depicts the role of road freight transport in the foreign trade transport of Azerbaijan. It becomes clear that road traffic plays a subordinated role in the export of the country. Its share dropped from 13.2 per cent in 1995 to 6.0 per cent in 1996. The main cause for this is, above all, the structure of the commodities for export, consisting largely of bulk goods, especially oil products. Exports to Iran and Turkey are mainly transported by road. The main reason being the lacking reliable or currently interrupted rail connections.

Tab. 2.2.1-16: Cross-border road freight transport in Azerbaijan

	1995		1996	
	'000 tons	Share in %*	'000 tons	Share in %*
Export				
Total	***218.3***	***13.2***	***139.6***	***6.0***
Russia	18.6	7.2	12.1	3.3
Georgia	18.6	4.7	4.3	0.6
Iran*	75.6	92.8	21.2	79.4
Turkey	33.4	96.5	67.7	93.5
Import				
Total	***548.6***	***37.1***	***779.8***	***40.1***
Russia	16.3	9.8	13.8	6.1
Georgia	7.7	10.8	4.8	6.6
Iran	270.0	98.8	238.5	99.1
Turkey	111.8	88.0	251.4	88.4

* Share in total cross-border traffic, for Iran without sea transport of oil products (1995 approx. 1 million t, 1996 approx. 1.6 million t)
Source: Customs authorities

The share of road traffic is relatively high as regards imports, however, which rose further in 1996 to a total of 40.1 per cent. Imports from Iran and Turkey are being transported more or less exclusively by road.

The share of road transport in exports will not rise significantly in the next years either, as the proportion of bulk goods will remain very high. The share of high-quality processed goods will rise a little. In domestic traffic, the share of road transport will increase markedly once more as a consequence of the further development of market-economy structures and progressing privatisation. It is mainly the development of reliable rail connections, especially in combined traffic, which is of decisive significance for the role of road traffic in imports. The share of road traffic in the transport volume will decrease with the re-instatement of the transit connection via Nakhichevan to Iran. The share of the railways will increase further with its stable quality connection Baku - Poti/Batumi, for transports to and, above all, from Turkey.

Georgia

In Georgia, the transport volume of freight transport by road dropped from 167.1 million tons in 1990 to 5.4 million tons in 1994. This equals a reduction to 3 per cent. As of 1995, however, there has been an increase in road freight transport. The transport volume rose by 55 per cent to 8.7 million tons in 1995 and the transport performance increased by 74 per cent to 130 million tkm. The share of road traffic in the entire freight transport thus was 65 per cent (transport volume). Measured in transport performance, the share of the road was only 10 per cent, however.

In international freight transport by road the share of road transport varies considerably, depending on the country of origin or destination, respectively (compare table 2.2.1-17).

Tab. 2.2.1-17: Share of road transport in border-crossing freight traffic of Georgia in 1996

Origin / Destination	Exports (%)	Imports (%)
Azerbaijan	8.7	2.3
Armenia	49.9	3.4
Iran	82.6	99.9
Russia	17.4	36.4
Ukraine	7.8	4.2
Turkey	49.1	83.8
Total	*21.8*	*15.8*

With the progressing re-structuring of the economy in the direction of a market economy, the share of road traffic will increase once more over the years to come. This applies especially to domestic traffic. The share of road transport will grow above-average in processed goods.

Inland waterways

Inland navigation shall only be included here in so far as it constitutes direct competition to railway traffic. This applies to the investigated countries only in the case of transportation from and to Baku with river-sea vessels.

This transport option is an alternative to railway traffic, above all, in the transport of bulk goods, e.g. oil or oil products, to the other CIS republics or from and to the Black Sea ports. At the moment, this possibility of transport is not being availed of, as Russia does not permit the passage of Azerbaijan ships via the Volga-Don Canal or has restricted it severely. Even on settling all political issues, there will still be technical restrictions for this transport route. Navigation on the Russian inland waterways is limited to about six months per year, due to adverse weather conditions. Furthermore, there are restrictions as to the permissible draught of the ships.

Thus, the possibilities of inland waterway navigation are relatively small as compared to the railways. Transport on inland waterways will be used as a supplement to railway transport but not as a complete alternative in future.

Pipelines

The future construction and use of pipelines for the transport of crude oil or oil products is of essential significance for the volume of rail traffic.

The international oil consortium (AIOC) as well as the Azerbaijan Government believe that two pipelines are going to be used for the transportation of the Azerbaijan oil. One is to lead through Chechnya to the Russian Black Sea port of Novorossijsk, the other through Georgia to the Black Sea coast (Supsa). A further possibility, through Turkey to the Mediterranean coast, is also being discussed. However, at the moment there are no definite statements as to the point in time of the inauguration and the scope of use for the different versions.

The following assumptions, which seem secure at the moment, were used for the forecast of the volume of railway traffic:

- only crude oil is going to be transported through the pipelines, which are to be built,
- a transport of crude oil by railway is not planned,
- there are no intentions of building or using pipelines for the transportation of oil products so far.

2.2.1.6 Scenarios for freight transport development

2.2.1.6.1 Total railway freight traffic

The assessment of future transport volume was conducted in two scenarios, an optimistic and a pessimistic one, and to the time horizons of 2000, 2010 and 2015. The assessment of the transport volume of 1997 served as an interim step.
The future development was calculated separately for the individual components of railway freight traffic:

Freight dispatch:

For to be able to calculate the dispatch volume in railway freight traffic, average annual growth rates were determined for the individual main types of goods, based on the overall economic development depicted in section 2.2.1.2.2 and section 2.2.1.3, for the respective time periods. In determining these growth rates, possible changes in the modal split of the transport modes were taken into consideration within the individual goods type groups (comp. section 2.2.1.5.5)

Export transports:

The determination of the annual growth rates was based on the development of the goods structure, the geographical structure of foreign trade and the development of production / domestic requirements.
Possible changes in the modal split and the utilisation of other, competing transport corridors (comp. section 2.2.1.5.2) were considered in dependence on the future geographical structure of foreign trade.

Import transports:

The future import volume was established with the help of the same calculation as for export.

Transit traffic:

The possible political development in the region and the usability of the transit corridors connected with it was considered as a decisive factor of influence for the future transit volume.
Furthermore the future economic development and the connected foreign trade development of the Central Asian republics (first of all Uzbekistan and Turkmenistan) were included in the assessment. The future geographical orientation of foreign trade in this region was also an important point in the assessment (comp. section 2.2.1.4). And the development of the foreign trade relations with Iran and Turkey were incorporated, as the region is an important transit area for both these countries.

Azerbaijan

The following basic assumptions were made for the two scenarios:

Optimistic scenario	Pessimistic scenario
Freight dispatch:	
❒ the entire freight dispatch volume of the railways will decrease once more in 1996, but as of 1997, a continuous increase will start, the increase in 1997 will be about 5 per cent, and up to the year 2000, the freight dispatch will increase annually by about 12 to 15 per cent, after that the growth rate will slow down to 2 to 5 per cent; ❒ the production of petrochemical products is of decisive importance for the entire dispatch volume, following a small decrease in 1996 production will grow again as of 1997, ❒ there will be above average growth rates from 1997 on also in building materials (rich national raw material deposits, increasing demand);	❒ the development in the pessimistic scenario differs only little from the optimistic one for most types of goods, and the growth rates are only insignificantly lower; ❒ the main differences between the two scenarios are determined by petrochemical products; following a decline in 1996, production will pick up again as of 1997, but after 2000 will be 7 to 10 million tons/a lower than the level of the optimistic scenario; ❒ especially for the item „other goods", the share of road transport will grow more rapidly, due to infrastructural problems of the railways;

❒ with regard to the modal split, there will only be insignificant changes in the type of goods important for the railways (mass goods), road transport will grow significantly in the area of high-value goods; crude oil will be transported by pipeline only	
Export transports: ❒ the amount of export transports will be determined mainly by the production level of petrochemical products, the volume produced over and above the level of national consumption will be exported; ❒ the share of countries in the Azerbaijan export for which a shipping through the Black Sea ports is favourable will increase; ❒ the export of petrochemical products to Iran (maritime traffic share) will not increase further, and will rather drop as of 2000; ❒ due to the opening of the Nakhichevan/ Dshulfa line, exports to Iran will be forwarded in this corridor once more;	❒ due to a lower production level in petrochemical products and a continuing domestic need of the same magnitude, the amount of goods remaining for export will be reduced; ❒ a slightly rising share of the Central Asian countries in Azerbaijan exports, thus a smaller transport volume on the network of the Azerbaijan Railways; ❒ the same or a slightly growing share of exports of petrochemical products to Iran by sea;
Import transports: ❒ in contrast to the exports, imports will rise slightly also in 1996 and later on; ❒ the food imports (food aid) will decrease; ❒ growing import volumes of equipment for oil production and other investment projects (e.g. Sumgait);	❒ differences to the optimistic scenario result, above all, from the lower annual growth rates;
Transit traffic: ❒ the optimistic scenario says that the important transit lines via Yalama to Russia and via Dshulfa to Iran will be available without restrictions again by the year 2000; ❒ already in 1996, the transit traffic via Baku/ferry will be about 200 Kt above the 1995 level (cotton and petrochemical products from Central Asia, investment goods and food products to Central Asia);	❒ the political situation will only allow for a limited scope of transit traffic from and to Russia via Yalama, traffic via Dshulfa will continue not to be possible at all; ❒ all existing transit routes will be available without restrictions by 2010, however, the volume will then be lower than in the optimistic scenario, due to a meanwhile other orientation of important transit flows;
Average transport distance: ❒ the average transport distance will remain at the level of 1995 (265 km) up to 1997 and will then rise to 438 km (opt.) / 421 km (pess.) by 2000;	

The main differences between the optimistic and the pessimistic scenario in Azerbaijan result from a different political development in terms of time, and from strongly varying transport volumes for oil products.

Based on the above scenarios, the following annual growth rates (in %) were applied to the development of transport volumes for the individual transport relations and main groups of commodities:

Tab. 2.2.1-18: Annual growth rates of rail freight traffic of Azerbaijan

	1997 - 2000		2001 - 2010		2011 - 2015	
	opt.	pess.	opt.	pess.	opt.	pess.
Freight dispatch:						
Oil products*						
Building materials	5...45	3...30	3.0...3.5	2.5...3.2	1.8...2.2	2.0
Metals	7.5...15	3.0...7.5	2.9...3.6	1.0...1.5	1.7...2.0	1.5...1.8
Cement	2...5.4	1.8...5.0	3.0...3.5	2.5...3.2	1.8...2.2	2.0
Cereals, foodstuff	2.9...3.4	1.5...3.0	2.0...2.5	2.0...2.3	2.0	1.8
Others	5.0...12.5	3.0...10.5	4.5...5.5	4.0...4.5	4.0...4.5	4.0
Exports	2.0...8.5	1.0...7.0	4.0...6.5	3.8...6.0	1.0...1.5	0.8...1.2
Imports	7.5...10.5	6.5...9.5	5.0...5.5	4.0...4.3	5.0...6.5	4.5...5.0

* For oil products see Pt. 2-2.1.6.3

Based on the framework conditions described above, the following total transport volumes and transport performance result for the forecast period:

Tab. 2.2.1-19: Transport volume of the Azerbaijan Railways up to the year 2015

	1995	2000		2010		2015	
		opt.	pess.	opt.	pess.	opt.	pess.
transport volume ('000 t)	9,073	20,102	12,992	29,690	20,519	34,825	23,685
transport performance ('000 000 tkm)	2,409	8,805	5,469	13,004	8,638	15,253	9,971

Georgia

The following scenario was developed for the Georgian Railways:

Optimistic scenario	Pessimistic scenario
Freight dispatch:	
❒ the entire freight dispatch volume of the railways will rise already in 1996, and there will be another 7 to 10 % increase in 1997;	❒ the development in the pessimistic scenario differs only a little from the optimistic one for most types of goods, and the growth rates are only insignificantly lower;
❒ there will be an average growth of approx. 10 % up to the year 2000;	❒ especially for the item „other goods", the share

❒ with regard to the modal split, there will only be little change in the type of goods important for the railways (mass goods), like in Azerbaijan, road transport will see considerable increases in high-value goods;	of road transport will grow more rapidly due to infrastructural problems of the railways;
Export transports: ❒ export transports will develop similarly in both scenarios, coupled with the volume of the entire freight traffic;	
Import transports: ❒ import transports will decrease significantly with the reduction of cereals supplies (food aid) in 1996 and 1997; ❒ commercial imports will develop with similar growth rates as the exports;	
Transit traffic: ❒ transit transports through Georgia will be determined mainly by exports of petrochemical products from Azerbaijan as well as by transits from and to Central Asia and Armenia, and the same assumptions apply as established for Azerbaijan above;	
Average transport distance: ❒ the average transport distance in both scenarios will be 270 km in 1997 and will rise to 340 km as of the year 2000.	

Based on the above scenarios, the following annual growth rates (in %) were applied to the development of transport volumes for the individual transport relations and main groups of commodities:

Tab. 2.2.1-20: Annual growth rates of rail freight traffic of Georgia

	1997 - 2000		2001 - 2010		2011 - 2015	
	opt.	pess.	opt.	pess.	opt.	pess.
Freight dispatch:						
Coal	15...25	5...12.5	4.7...5.2	1.8...2.3	2.5...3.2	3.0
Oil products	7.5...8.5	4.8...5.5	3.0	2.4...2.9	2.7...3.0	2.5...2.9
Building materials	10...25	9.0...12.5	4.5...6.0	4.0...5.2	2.5...3.0	3.0
Ore	7.0...8.5	5.0...10.0	1.8...2.5	1.5...2.0	2.4...3.3	2.8
Cement	10...25	5.5...12.5	4.5...6.5	3.5...4.5	2.5...3.0	2.4...2.9
Cereals, foodstuff	6.5...9.0	4.5...7.5	1.7...2.2	1.5...2.0	2.6...2.8	2.5...2.7
Metals	15...17.5	5.0...8.0	5.5...6.5	3.5...4.5	2.9	2.9
Others	7.5...11.5	4.5...7.0	3.0...4.0	1.8...2.2	1.8...3.4	2.5...3.0
Exports	7.5...12.0	3.0...6.5	5.0...6.5	4.5...6.0	5.0	4.8
Imports	1.5...5.0	-2.5...4.5	2.0...2.5	1.8...2.4	2.5	2.0

Using these growth rates, the following transport volumes are deduced for the forecast period:

Tab. 2.2.1-21: Transport volume of the Georgian Railways up the year 2015

	1995	2000		2010		2015	
		opt.	pess.	opt.	pess.	opt.	pess.
transport volume ('000 t)	4,700	9,525	4,477	15,268	7,611	17,470	9,135
transport performance ('000 000 tkm)	1,246	3,238	1,522	5,191	2,588	5,940	3,106

The development of the individual components of rail freight traffic is depicted in the graphs below. The detailed figures are contained in Annexes 2.2.1-9 to 2.2.1-10.

Fig. 2.2.1-21: Development of Azerbaijan rail freight traffic up to 2015 (optimistic scenario)

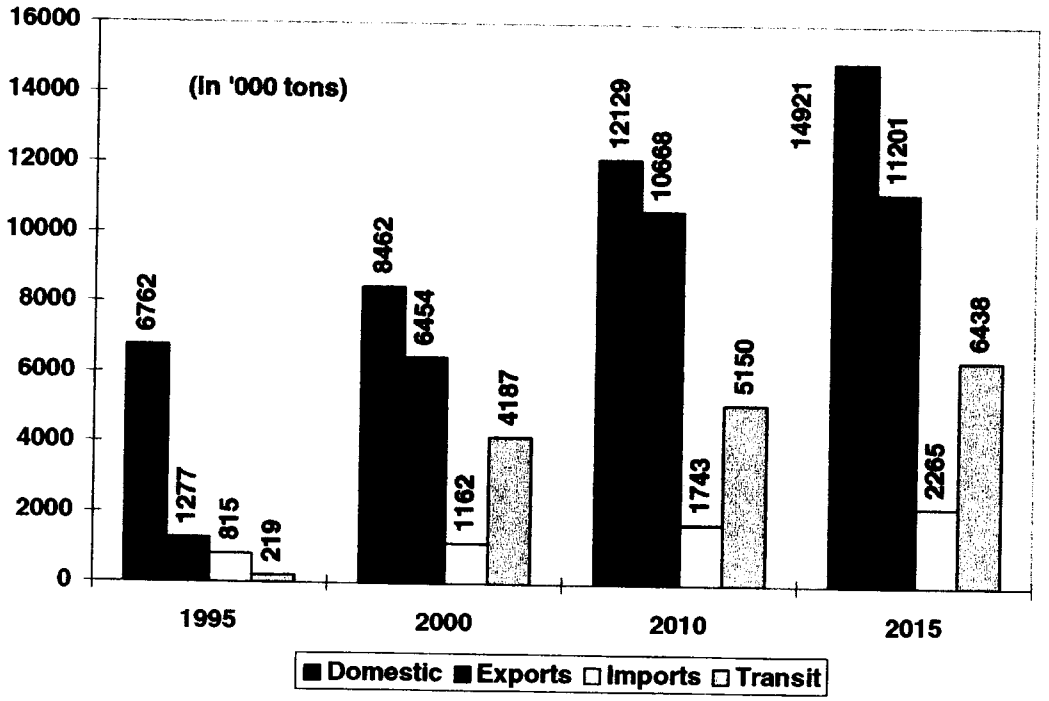
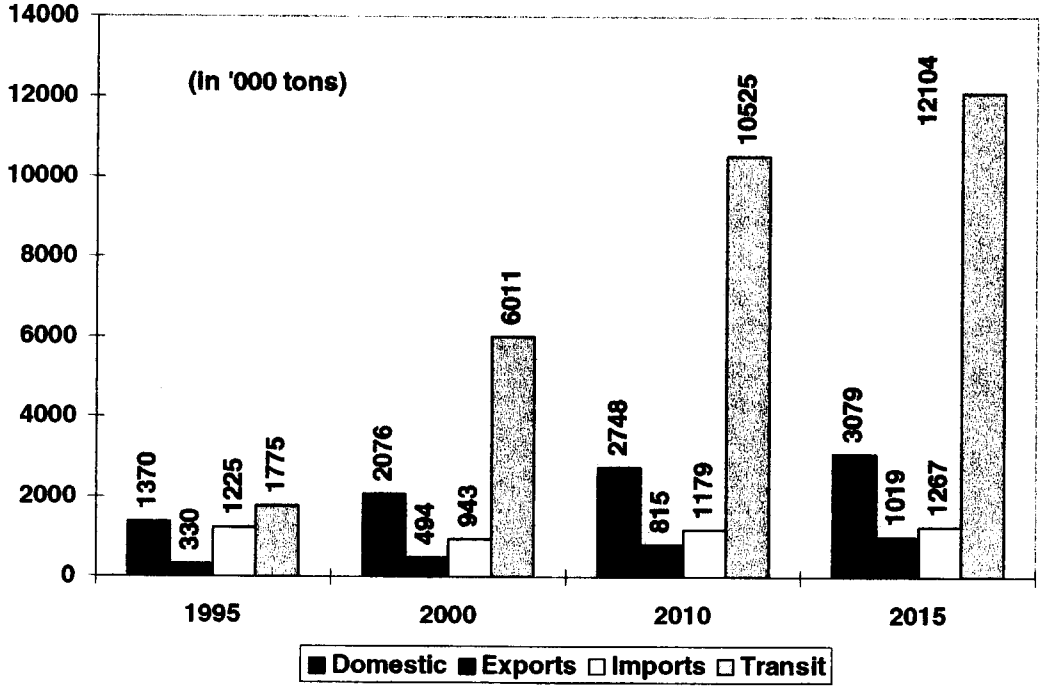


Fig. 2.2.1-22: Development of Georgian rail freight traffic up to 2015 (optimistic scenario)



The forwarding of the petrochemical products produced in Azerbaijan will maintain a dominating position in the rail freight traffic of the country. Their share in the total amount of goods transported was 70.7 per cent in 1995. It will have reached 59,1 per cent (optimistic scenarios) by the year 2000, in 2010 it will be 62.7 per cent and in 2015 the share will stand at 61.5 per cent. Parallel, the share of transit transports will rise considerably during the period under investigation. Whereas the share of transit transports was still 2.4 per cent in 1995, it will have reached 20,8 per cent (in the optimistic scenario) already in the year 2000. In the following years it will remain at about that level.

Transit traffic will gain a dominating role in the rail freight traffic of Georgia. Already in 1995, the share of transits in the total amount forwarded was high at 37.8 per cent, as compared to Azerbaijan. This share will already be 63,1 per cent (optimistic scenario) in the year 2000, and after that it will raise to about 70 per cent by the year 2015.

There will only be insignificant changes, as compared to the current situation, in the goods structure of the two countries.

2.2.1.6.2 Traffic forecast for main transport corridors

Baku - Poti / Batumi

Based on the division of the freight transport flows along this line according to line sections and main components in section 2.2.1.5.2, a possible development during the forecast period was assessed also in two scenarios. This was based on the assumptions drawn up for the entire freight traffic in section 2.2.1.6.1. With regard to the current conditions and assumptions mentioned in section 2.2.1.5.2, for instance, concerning the role of the Black Sea ports of Poti and Batumi, there will be no decisive changes during the forecast period.

The goods flows resulting from this are depicted in the graphs of Figures 2.2.1-23 to 2.2.1-28 for the optimistic scenario for the years of 2000, 2010 and 2015. Detailed figures for both scenarios are contained in Annexes 2.2.1-11 to 2.2.1-14.

There will only be insignificant changes in the structure of the type of goods for the forecast development of the freight traffic volume in the transport corridor of Baku - Tbilisi - Poti/Batumi.

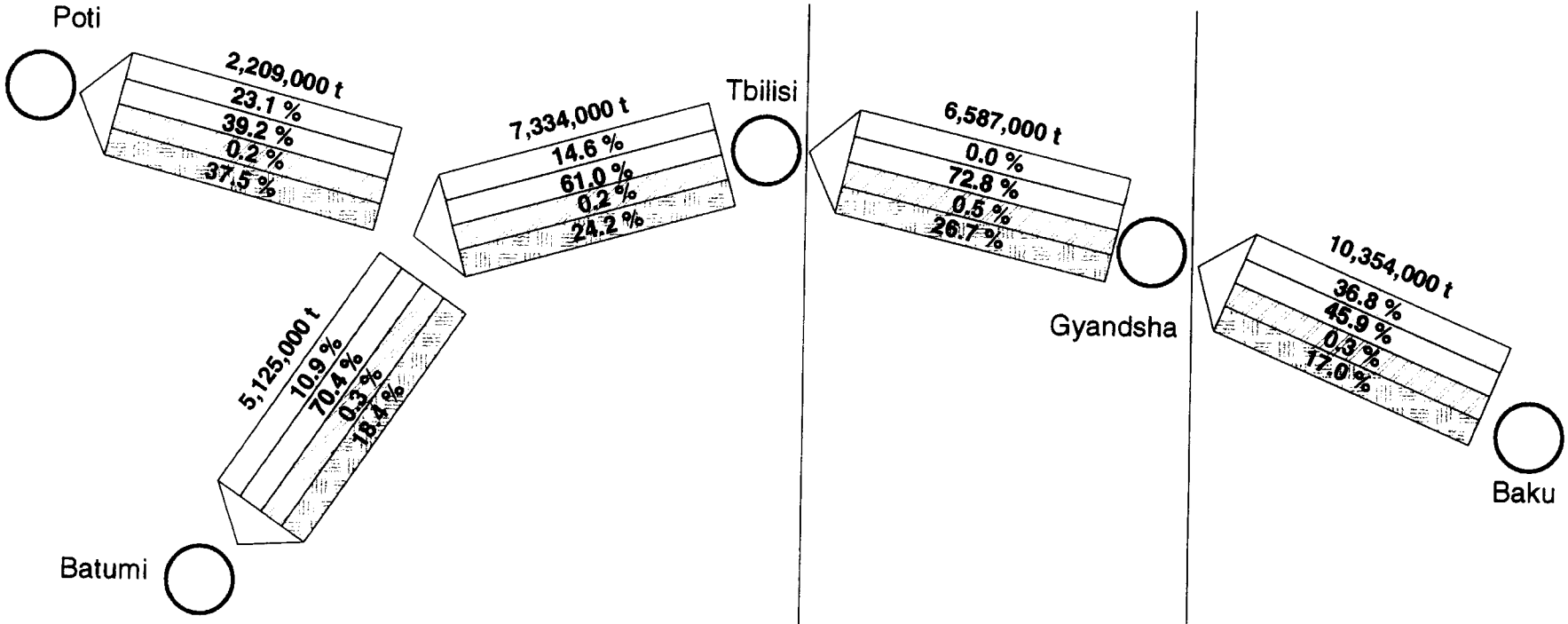
Tab. 2.2.1-21: Development of the goods structure in the corridor of Baku - Tbilisi - Poti/Batumi (westbound traffic)

Type of goods	East - West - direction (opt. scenario)			
	1995	2000	2010	2015
total	100.0	100.0	100.0	100.0
petrochemical products	95.5	89.9	89.4	88.9
coal, coke	0.1	0.0	0.0	0.0
ore	0.0	0.9	0.9	0.8
ferrous metals	0.3	1.5	1.7	1.8
timber	0.1	0.0	0.0	0.1
mineral building materials	0.5	0.3	0.4	0.6
cement	0.3	0.1	0.1	0.2
mineral fertiliser	0.0	0.0	0.0	0.0
cereals	0.3	0.1	0.1	0.1
others	2.4	7.3	7.3	7.5

Petrochemical products will continue to determine transport in the westbound traffic. Their share will decrease to slightly below 90 per cent by the year 2015. On the other hand, the share of other processed products will increase a little.

There are only insignificant differences between the optimistic and the pessimistic scenario with regard to the structure of the type of goods.

Fig. 2.2.1-23: West-bound traffic 2000 - Optimistic scenario



Tbilisi-Poti	Tbilisi-Batumi	Gyandsha-Tbilisi	Baku-Gyandsha	
510,000 t [2]	560,000 t [2]	0 t	3,826,000 t [1]	Domestic traffic
867,000 t	3,609,000 t	4,793,000 t	4,734,000 t	Exports Azerbaijan
4,000 t	14,000 t	35,000 t	35,000 t	Imports Georgia
828,000 t	942,000 t	1,759,000 t	1,759,000 t	Transit

[1] incl. Azeri imports

[2] incl. Georgian exports

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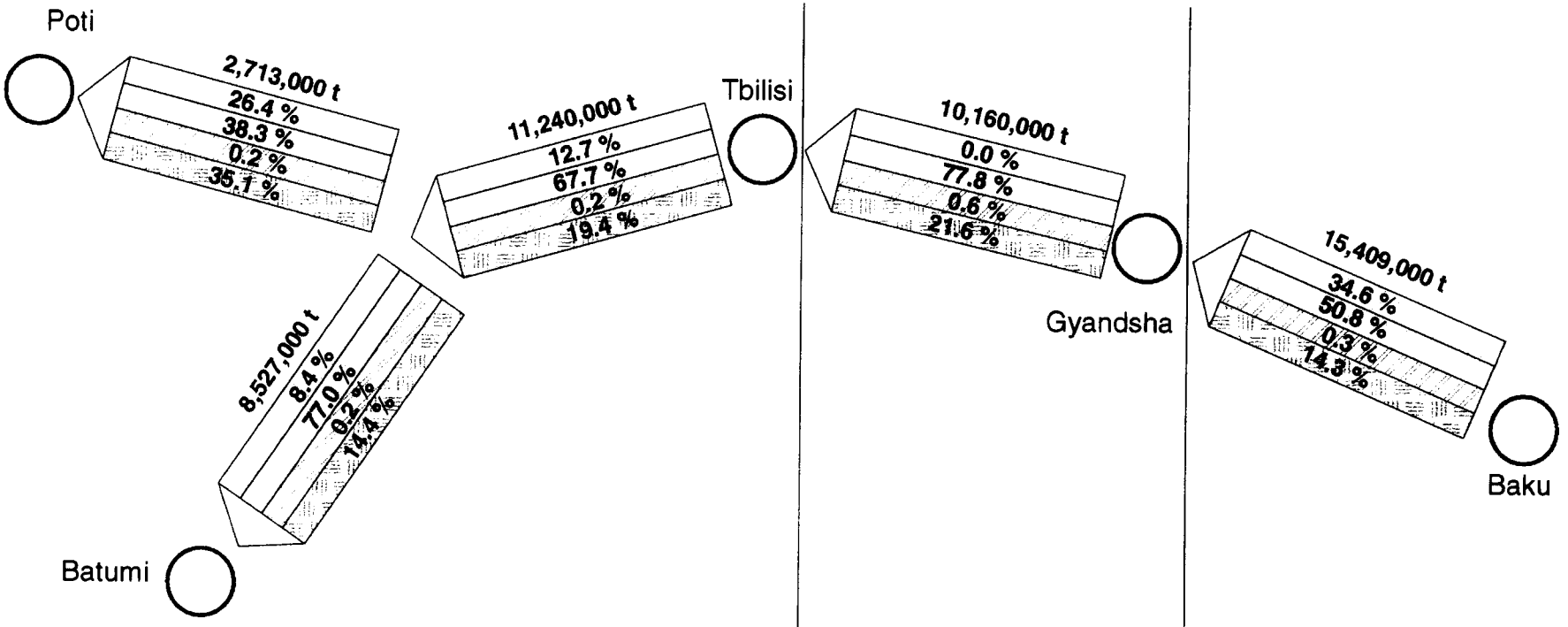
Fig. 2.2.1-24: West-bound traffic 2010 - Optimistic scenario



	Tbilisi-Poti	Tbilisi-Batumi	Gyandsha-Tbilisi	Baku-Gyandsha
Domestic traffic	715,000 t [2]	717,000 t [2]	0 t	5,347,000 t [1]
Exports Azerbaijan	1,041,000 t	6,568,000 t	7,909,000 t	7,811,000 t
Imports Georgia	5,000 t	18,000 t	53,000 t	53,000 t
Transit	952,000 t	1,224,000 t	2,198,000 t	2,198,000 t

[1] incl. Azeri imports [2] incl. Georgian exports

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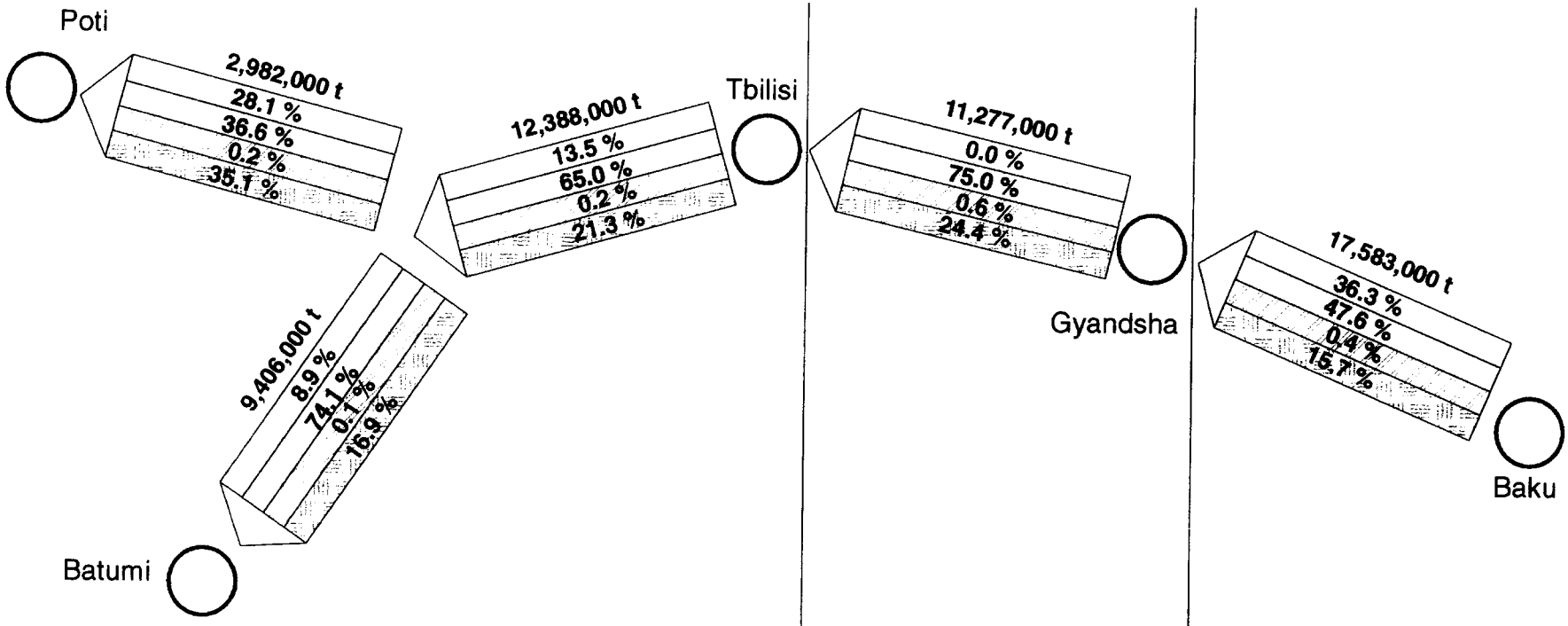
Fig. 2.2.1-25: West-bound traffic 2015 - Optimistic scenario



Tbilisi-Poti	Tbilisi-Batumi	Gyandsha-Tbilisi	Baku-Gyandsha	
837,000 t [2]	833,000 t [2]	0 t	6,411,000 t [1]	Domestic traffic
1,093,000 t	6,962,000 t	8,463,000 t	8,358,000 t	Exports Azerbaijan
5,000 t	19,000 t	66,000 t	66,000 t	Imports Georgia
1,047,000 t	1,592,000 t	2,748,000 t	2,748,000 t	Transit

[1] incl. Azeri imports

[2] incl. Georgian exports

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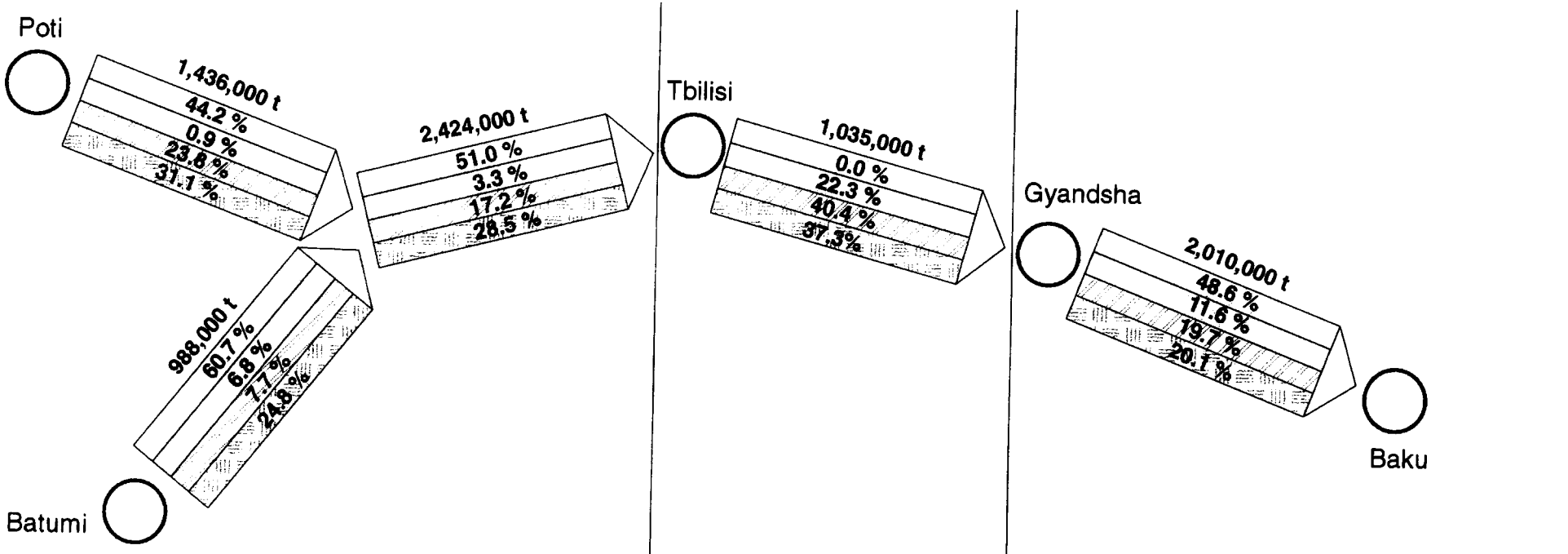
Fig. 2.2.1-26: East-bound traffic 2000 - Optimistic scenario



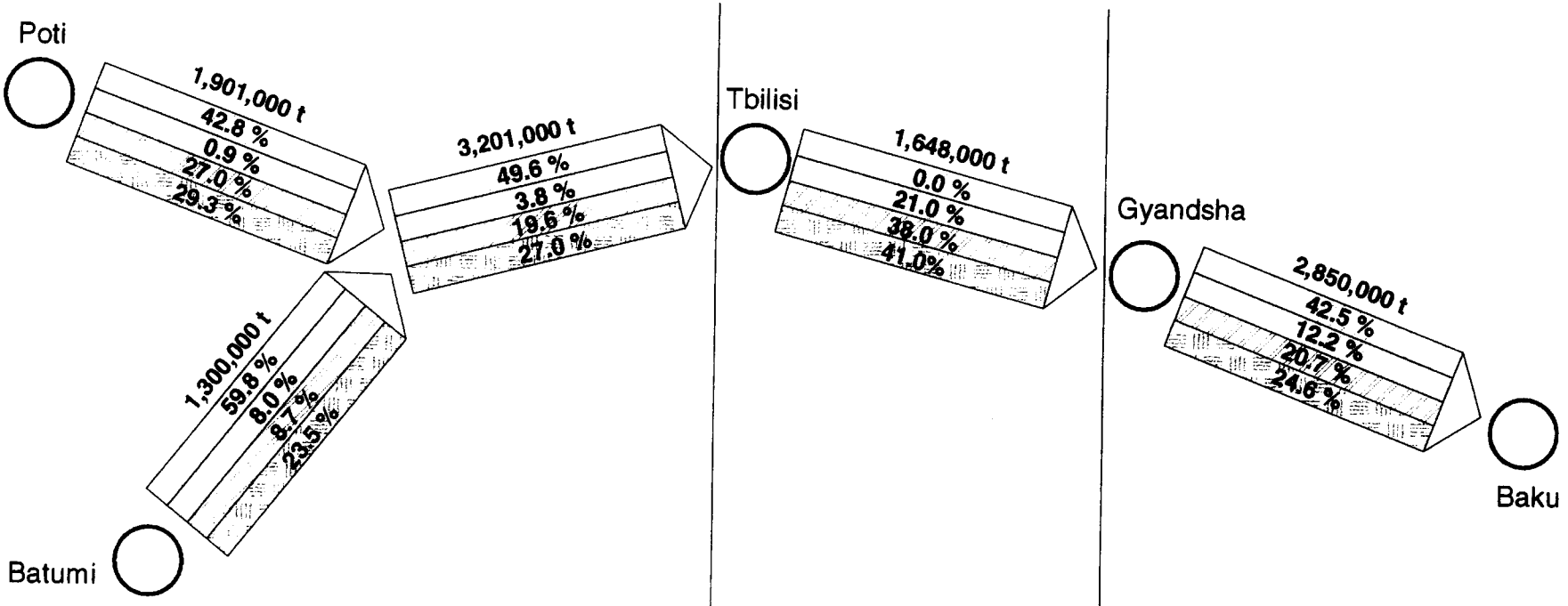
Poti-Tbilisii	Batumi-Tbilisi	Tbilisi-Gyandsha	Gyandsha-Baku	
635,000 t [1]	600,000 t [1]	0 t	1,022,000 t [2]	Domestic traffic
13,000 t	67,000 t	231,000 t	224,000 t	Exports Georgia
342,000 t	76,000 t	418,000 t	378,000 t	Imports Azerbaijan
446,000 t	245,000 t	386,000 t	386,000 t	Transit

[1] incl. Georgian imports

[2] incl. Azeri exports

aserbe42.cdr

Fig. 2.2.1-27: East-bound traffic 2010 - Optimistic scenario

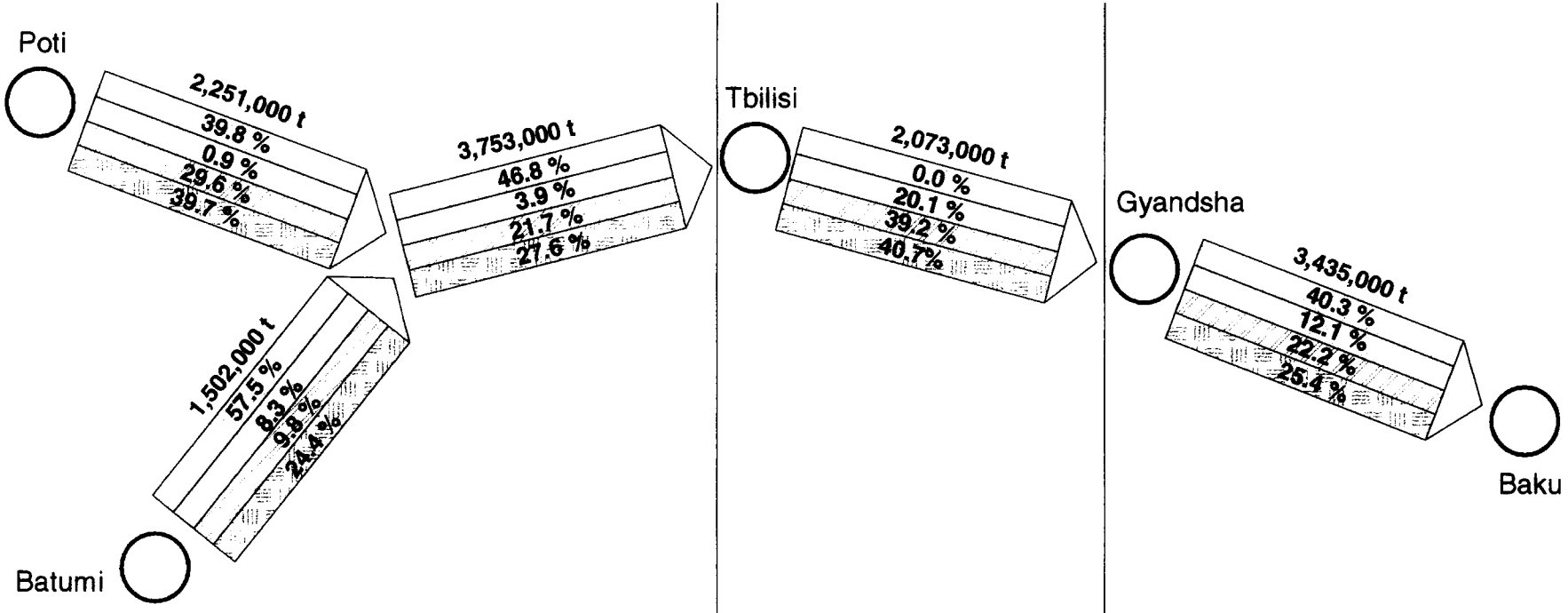


Poti-Tbilisii	Batumi-Tbilisi	Tbilisi-Gyandsha	Gyandsha-Baku	
813,000 t [1]	777,000 t [1]	0 t	1,272,000 t [2]	Domestic traffic
17,000 t	104,000 t	347,000 t	336,000 t	Exports Georgia
513,000 t	113,000 t	626,000 t	567,000 t	Imports Azerbaijan
558,000 t	306,000 t	675,000 t	675,000 t	Transit

[1] incl. Georgian imports [2] incl. Azeri exports

aserbe43.cdr

Fig. 2.2.1-28: East-bound traffic 2015 - Optimistic scenario



Poti-Tbilisii	Batumi-Tbilisi	Tbilisi-Gyandsha	Gyandsha-Baku	
895,000 t [1]	863,000 t [1]	0 t	1,452,000 t [2]	Domestic traffic
20,000 t	125,000 t	416,000 t	403,000 t	Exports Georgia
667,000 t	147,000 t	814,000 t	737,000 t	Imports Azerbaijan
669,000 t	367,000 t	843,000 t	843,000 t	Transit

[1] incl. Georgian imports [2] incl. Azeri exports

Tab. 2.2.1-22: Development of the goods structure in the corridor of Baku - Tbilisi - Poti/Batumi (eastbound traffic)

Type of goods	West - East - direction (opt. scenario)			
	1995	2000	2010	2015
total	100.0	100.0	100.0	100.0
petrochemical products	1.1	1.2	1.2	1.0
coal, coke	0.0	0.1	0.1	0.1
ore	12.6	12.9	12.8	10.6
ferrous metals	8.3	15.6	16.2	18.7
timber	0.0	0.0	0.0	0.0
mineral building materials	2.8	7.5	8.4	8.5
cement	0.1	0.6	1.3	1.2
mineral fertiliser	3.7	4.3	4.3	4.1
cereals	62.3	35.5	30.5	28.7
others	9.1	22.3	25.2	27.1

The share of cereals will drop considerably in the eastbound traffic, due to the decreasing food aid for the countries of the region. The share of investment goods, consumer goods and other processed goods will grow.

There are only insignificant differences between the optimistic and the pessimistic scenario with regard to the structure of the type of goods, also in the eastbound traffic.

Baku - Nakhichevan / Dshulfa - Iran

The scope of future freight flows along this corridor depends, above all, on the further political development in the region. In drawing up the forecast, it was assumed that the traffic to and from Nakhichevan will operate normally as of the year 2000, in the optimistic scenario, and that railway traffic will be resumed along this line as of the year 2005 at the earliest, in the pessimistic scenario.

The freight flows were first of all broken down into their individual components: domestic traffic, exports/imports Azerbaijan, exports/imports Armenia as well as transit traffic to and from Iran. An initial level was assumed for domestic traffic which corresponds with the total level of freight traffic of the Azerbaijan Railways in the year 2000, as compared to the initial basis of 1988.

Transit traffic mainly consists of freight flows between Iran and Russia as well as the other CIS republics and the Scandinavian countries through the corridor of Baku - Yalama. It has to be added that it is especially wood, wood products and paper cardboard which are transported in the North-South direction.

The same rates of increase as for the entire railway traffic of Azerbaijan (or Armenia respectively) were used for the development of the individual segments (comp. section 2.2.1.6.1). The difference between the optimistic and pessimistic scenarios as of

the year 2010 is greater, particularly in transit traffic than on other line sections, as, due to the late re-instatement of the traffic, transport flows will have shifted to other corridors or modes of transport.

Tab. 2.2.1-23: Freight traffic in the Baku - Nakhichevan / Dshulfa corridor

Baku - Nakhichevan:

(in '000 t)

	2000		2010		2015	
	opt.	pess.	opt.	pess.	opt.	pess.
Domestic traffic	265	-	379	322	451	417
Azerb. exports	355	-	630	367	690	378
Transit to Iran	1,063	-	1,175	716	1,288	926
Armenian imports	253	-	317	268	431	294
Total	*1,936*	-	*2,501*	*1,727*	*2,860*	*2,191*

Nakhichevan - Baku:

(in '000 t)

	2000		2010		2015	
	opt.	pess.	opt.	pess.	opt.	pess.
Domestic traffic	44	-	63	56	74	65
Azerb. imports	151	-	321	266	365	314
Transit from Iran	310	-	315	151	421	260
Armenian exports	30	-	32	28	58	42
Total	*535*	-	*731*	*501*	*918*	*681*

Baku - Astara

In future, this line will remain rather insignificant for railway freight traffic. This railway link does not play a great role in the considerable exchange of goods between Azerbaijan and Iran. Exports and imports of Azerbaijan from and to Iran via Astara will be transported by road to a large extent, as the cargo would have to be shifted onto trucks in Astara anyway. This connection will in future be used more than today for transits from and in the direction of Russia via Yalama. It has to be added that the connection via Dshulfa or the sea route will bear the main part.

Tab. 2.2.1-24: International freight traffic in the Baku - Astara corridor

Baku - Astara:

(in '000 t)

	2000		2010		2015	
	opt.	pess.	opt.	pess.	opt.	pess.
Azerb. exports	109	75	115	90	115	90
Transit to Iran	45	30	75	45	95	60

Astara - Baku:

(in '000 t)

	2000		2010		2015	
	opt.	pess.	opt.	pess.	opt.	pess.
Azerb. imports	35	15	46	27	85	30
Transit from Iran	35	30	55	40	75	56

Baku - Yalama

In future, this line will be of significance, above all, for international traffic. It is of more or less no importance for the domestic railway traffic of Azerbaijan (with the exception of the Baku - Sumgait section). The improvement of the political situation in Chechnya, in order to prevent any impediment of railway traffic in future, is the prerequisite for a growth of transport volumes along this line. The forecast is based on the assumption that normal railway freight traffic can be conducted along this route once more as of the year 2000.

In future, some 15 per cent of all Azerbaijan exports by rail will run through this corridor, and in the case of imports, the percentage is approximately 30 per cent. (The line to the Black Sea ports of Poti /Batumi represents the main connection for Azerbaijan exports)

On re-instating the railway line from and to Nakhichevan - Dshulfa - Iran, the connection Baku - Yalama - Russia will gain in importance significantly for transit traffic. The following transport volumes were identified for international traffic during the forecast period:

Tab. 2.2.1-25: International freight traffic in the Baku - Yalama corridor

Baku - Yalama:

(in '000 t)

	2000		2010		2015	
	opt.	pess.	opt.	pess.	opt.	pess.
Azerb. exports	965	432	1,564	927	1,638	942
Transit to Russia	809	419	921	647	1,238	889

Yalama - Baku:

(in '000 t)

	2000		2010		2015	
	opt.	pess.	opt.	pess.	opt.	pess.
Azerb. imports	365	348	537	498	736	703
Transit from Russia	1,863	335	2,134	1,395	2,616	1,860

Tbilisi - Armenia - Dshulfa - Iran

Railway transit through Armenia will develop with the normalisation of the political situation in the region and the re-instatement of railway traffic via Nakhichevan / Dshulfa. However, there will be strong competition by the traditional transit line through Azerbaijan, along which the main part of transit from and to Iran will be handled also in future.

It will be primarily foreign trade goods of Georgia as well as transit traffic between Iran and Ukraine as well as Russia which will run through Armenia in transit. The foreign trade transports of Armenia via the Black Sea ports constitute an important share of the cargo flows along the Tbilisi - Armenia section.

Tab. 2.2.1-26: International freight traffic in the Tbilisi - Armenia - Dshulfa corridor

Southbound:

(in '000 t)

	2000		2010		2015	
	opt.	pess.	opt.	pess.	opt.	pess.
Exports Georgia	44	11	83	37	125	68
Imports Armenia	403	617	650	499	723	571
Transit	240	-	302	156	378	195

Northbound:

(in '000 t)

	2000		2010		2015	
	opt.	pess.	opt.	pess.	opt.	pess.
Imports Georgia	75	-	183	132	207	167
Exports Armenia	106	142	214	148	303	220
Transit	180	-	225	112	281	139

Tbilisi - Gyumri - Turkey

The same may be said for this corridor as for the Tbilisi - Nakhichevan line as regards the initial political situation. The transport volume in the cross-border railway traffic between Turkey and Armenia, however, will remain insignificant during the forecast period.

Transports between Turkey and Azerbaijan as well as the Central Asian Republics will constitute the main volume, which will reach a scope of 130 thousand tons (in both directions) by the year 2000. This relates to the optimistic scenario, traffic will only be resumed in the year 2005 at the earliest in the pessimistic scenario.

Foreign trade transports between Turkey and Georgia in railway traffic along this line will take on a volume of 40 thousand tons by the year 2000 (optimistic scenario, traffic in both directions).

2.2.1.6.3 Traffic forecast for main groups of commodities

Oil products

The following assumptions were the basis for preparing the traffic forecast for oil products:

- Transportation of oil products by pipeline is not envisaged during the forecast period
- Crude oil will be transported exclusively by pipeline.

Proceeding from the situation described in section 2.2.1.3.1, production, domestic consumption, and exports of oil products will develop in Azerbaijan within the forecast period as follows:

Tab. 2.2.1-27: Production and exports of oil products up to the year 2015

(in '000 tons)

	1995	2000		2010		2015	
		opt.	pess.	opt.	pess.	opt.	pess.
Production	8,923	16,500	9,500	22,000	14,000	25,000	15,500
Domestic cons.	6,733	6,950	6,375	8,100	7,835	10,250	9,085
Exports	2,190	9,550	3,125	13,900	6,165	14750	6,415

The percentage of rail transport in the overall transport of oil products will rise from 72 per cent in 1995 to 85.6 per cent (82.1 per cent pess. scenario) in 2015. In the export of oil products the percentage of rail transport will rise from 48.6 per cent in 1995 to 65 per cent (60 per cent pess. scenario) in 2015. The remaining export volume not transported by rail will for a minor part be transported by road, but mainly by sea. The most important destinations in sea-borne export are Iran and Russia.

Tab. 2.2.1-28: Rail freight dispatch of oil products in Azerbaijan

(in '000 t)

	2000		2010		2015	
	opt.	pess.	opt.	pess.	opt.	pess.
Rail freight dispatch of oil products	11,880	7,120	18,611	11,483	21,403	12,718
Exports of oil products by rail	5,730	1,735	9,035	3,690	9,588	3,857
Exports by other transport modes	*3,820*	*1,390*	*4,865*	*2,475*	*5,162*	*2,558*

The transport of oil products by railway will be distributed to the main corridors during the forecast period as follows:

Tab. 2.2.1-29: Main destinations of Azerbaijan exports of oil products by rail

(in '000 t)

Destination	2000		2010		2015	
	opt.	pess.	opt.	pess.	opt.	pess.
Georgia	397	325	407	342	413	345
Black sea ports	3,842	790	6,467	2,063	6,943	2,374
Yalama - Russia	893	390	1,329	627	1,465	736
Nakhichevan - Armenia/Iran	315	-	504	260	587	295

In addition, oil products from Central Asia will be transported in transit through Azerbaijan. The transport volumes will rise from 530 / 405 thousand tons (opt. / pess.) in the year 2000 to 825 / 620 thousand tons in 2015.

Cotton

During the next years the production - and thus the export - will not rise very much. The reasons for this were described in detail in section 2.2.1.5.3. For the forecast period, the following export volumes from the Central Asian republics (without Kazakhstan) are being assumed (in '000 tons):

	optimistic	pessimistic
2000	1,350	1,200
2010	1,400	1,200
2015	1,450	1,250

The use of the railway corridors through Azerbaijan and Georgia depends, above all, on the future distribution of the sales markets for Central Asian cotton. Europe is playing an increasing role for the export of these countries. Presently, the exports to this region are conducted mainly via Baltic Sea ports (Riga).In 1995, for instance, 36 per cent of all of Uzbekistan's cotton exports were shipped via the port of Riga. It is assumed that in future the port of Poti because of its favourable geographic location and thus considerably shorter transport distances as compared to Riga will play an ever more important role for the cotton exports of the Central Asian republics. This, however, requires the creation of appropriate conditions for storage and of various services in the port.

As regards future cotton exports from the Central Asian republics it is assumed that the percentage of the port of Poti in the overall exports will rise from 20 per cent in 2000 to 30 per cent in 2015 (equivalent from 15 to 20 per cent, respectively, in the pessimistic scenario). Thus for the forecast period the following transit transports through Azerbaijan and Georgia result (in '000 tons):

	optimistic	pessimistic
2000	270	180
2010	350	240
2015	435	250

Containers

There are three major growth potentials regarding the goods volume in the Caucasian railways' container traffic.

- further increase of foreign trade of the states in the region and, consequently, increase of the overall transport volume in railway traffic;
- increase of the degree of containerisation in goods traffic from and to the region;
- shifting of container transports from road to rail.

The total incoming container volume at Poti port will grow by an annual 25 - 30 per cent for Azerbaijan and Central Asia and 10 - 25 per cent for Armenia and Georgia by the year 2000 (opt. scenario). As of then, the annual growth up to the year 2010 will be from 10 - 15 per cent, and as of 2011 it will be an annual 5 per cent. In the pessimistic scenario, the corresponding annual growth rates are 15 - 20 per cent for Azerbaijan / Central Asia and 5 - 10 per cent for Armenia / Georgia up to the year 2000. As of then the annual growth rates for all counties will be 5 per cent. Particularly during the first years these increase rates are clearly above those for the overall traffic volume.

The most important reason for this is the expected increase in the degree of containerisation of the transports in foreign trade to the countries of the Caucasus and Central Asia. At present, the percentage of container transports in the overall railway traffic of Azerbaijan amounts to only about 0.1 per cent. The percentage of container traffic in Armenia and Georgia is equally low. In Germany, for example, the share of combined transport in total rail freight transport was 10.2 per cent in 1996.
Furthermore, the percentage of high-quality consumer goods and investment goods in the imports of the states concerned will further increase.

As regards the volume to Central Asia, it was assumed that the containerisation by 2000 will have reached the same level as with transports to Azerbaijan.

A similar development with respect to overall volume and containerisation is also assumed for the exports of these countries, resulting in that the proportion between loaded / empty containers in traffic between Poti and Azerbaijan, Armenia, Georgia will nearly remain the same.

The development as to the proportion of loaded / empty containers for transports from and to Central Asia, however, is assessed differently. Container transports from Central Asia to Poti to a large extent are determined by the transport of cotton. The Central Asian republics intend to deliver high-quality cotton via Turkmenbashi / Baku to Poti. Uzbekistan declared that it intends to send a total of 35,000 tons per year in containers by using this transport variant. For the purpose of the traffic forecast a start of these deliveries was assumed for 1997 with at first 500 TEU; full-scale deliveries will then be reached in 2000. This results in a considerably higher percentage of loaded containers in the East-West direction for container traffic from and to Central Asia. In 2000 the proportion loaded / empty containers will be about 4:1 (optimistic scenario). Along with increase in the eastbound container traffic up to the year 2015 this proportion will change to about 2:1.

The future percentage of road traffic in the container transports is of vital importance to the transport volumes in the railways' container traffic. Here, a short-term heavy increase of the railways' percentage is assumed. Experience gained during the introduction of the "Trans-Caucasian Logistic Express" shows that the railways have a clear competitive advantage as compared to road traffic, if they offer regular, reliable, favourably priced and, above all, safe transport services to the customers. The introduction of the "Trans-Caucasian Logistic Express" on the route Poti - Tbilisi - Baku in November 1996 led to a precipitous rise in the railways' container traffic. One can therefore proceed from the assumption that the railways will utilise the advantages they have in long-distance transports (Poti - Baku, Poti - Yerevan, Poti - Central Asia) as compared to road traffic. A further asset in traffic from and to Armenia is that the railways are additionally advantageous because of the difficult geographic conditions, which becomes especially apparent in the winter months. For the traffic forecast therefore the following assumptions were made with respect to the modal split in container traffic:

The share of railway transport in total container traffic will rise to 40 per cent in the relations of Poti - Baku in 1997, and as of the year 2000, it will be 65 per cent (pessimistic scenario 30 % / 45 % respectively). The share of the railways in the Poti - Yerevan relation will be 45 per cent in 1997 and as of 2000 it will also be 65 % (pessimistic scenario 40 % / 50 % respectively). In the Poti - Tbilisi direction the share of the railways in the total container traffic will reach 10 per cent in 1997, and as of 2000 it will be at 25 % (respectively 7,5 % / 15 % in the pessimistic scenario). This lower share of rail transport is due to the considerably shorter distance from Poti to Tbilisi and thus more favourable conditions for road transport.

Based on these basic assumptions, the following container flows result for railway traffic during the forecast period:

Tab. 2.2.1-30: Freight volumes in container traffic up to 2015

(loaded containers / TEU)

	1997		2000		2010		2015	
	opt.	pess.	opt.	pess.	opt.	pess.	opt.	pess.
Poti - Tbilisi	580	400	2,124	1,014	4,779	1,902	5,974	2,378
Poti - Baku	820	566	3,003	1,434	6,757	2,689	8,446	3,361
Poti - Turkmenb.	94	86	1,043	751	1,760	1,172	2,200	1,465
Poti - Armenia	1,936	1,653	4,050	2,708	9,113	3,627	11,391	4,534
Tbilisi - Poti	174	120	637	304	1,434	685	1,792	856
Baku - Poti	180	124	659	315	1,483	708	1,854	885
Turkmenb. - Poti	500	500	4,300	2,470	4,720	2,690	4,910	2,880
Armenia - Poti	493	421	1,031	689	2,319	1,108	2,899	1,385

2.2.1.7 Passenger traffic forecast

2.2.1.7.1 Methodology

The application of traditional West European mathematical and statistical procedures for forecasting passenger flows is connected with considerable problems in predicting the development of passenger traffic in the Caucasus republics and would lead to very doubtful results. The reasons for this are especially

- the structural break due to serious political and economic changes in the transition from the centrally planned economy to a market economy, starting in 1988/89,
- the change in values and travel motivations in this transition, sparked off by a changed income and expenditure structure within the population,
- changed destinations for private and business trips due to the disappearance of state restrictions and a re-orientation of trade and tourism relations,
- the disappearance of state regulations for the modal split of transport as well as the dismantling of state regulations and subsidies of fares.

It is more or less impossible to register these manifold changes of the different factors of influence, which have grave consequences, with traditional procedures.

That is the reason why a methodology specially geared to the conditions of the CIS states was chosen, which enables a more exact consideration of the special conditions for the development of passenger traffic in the countries to be investigated, by including a number of most varied factors of influence and scrutinising and assessing these using the specific filter of the respective country.

Selecting from the most diverse factors of influence on travel demand and choice of the mode of transport, the following were subjected to an assessment of the current situation and their development:

- ❒ political situation in the country and the region
- ❒ macroeconomic development
- ❒ development of the population
- ❒ income, rate of unemployment
- ❒ foreign trade and international economic relations
- ❒ active and passive tourism
- ❒ individual car ownership.

On the basis of assessing these factors specifically for the individual country and a special interlinking, the possible development of total passenger traffic was established. Derived from these findings, annual growth rates were calculated for the transport volume, heeding also the probable changes in the modal split. The differentiation was between:

- regional traffic (generally up to 50 km)
- domestic traffic (long-haul traffic)
- international traffic.

Usually the year 1995 served as a starting point, the level of 1988/89 and the development over the subsequent years was, however, included in the assessment as an orientation. The assessment was conducted in the form of an optimistic and a pessimistic scenario.

2.2.1.7.2 Present volumes of passenger traffic

Similarly to freight traffic, there have been serious changes also in passenger traffic over the past years. Both the number of persons transported as well as the transport performance have decreased considerably in all three republics. This is true without exception for all three modes of transport. During these years some significant shifts in the modal split have emerged. The current situation is depicted for each of the three countries individually in the following:

Azerbaijan

In Azerbaijan, too, the number of passengers handled by public transport services dropped considerably between the years of 1989 to 1995. This applies both to the railways as well as bus services.

Tab. 2.2.1-31: Passenger transport in Azerbaijan

	1989	1991		1993		1995	
	'000 000	'000 000	% to '89	'000 000	% to '89	'000 000	% to '89
Rail	19.6	15.7	80.1	9.8	50.0	9.0	45.9
Bus	298.4	279.4	93.6	193.6	64.9	150.4	50.4
Air	2.2	2.0	90.9	1.5	68.2	...	

The data on bus traffic does include public transport in towns and cities, whose share was about 45 per cent in 1995. Unfortunately, there are no figures on private bus services for Azerbaijan either. In the state-run transport business, the number of passengers transported between 1989 to 1995 dropped by nearly a half. Considering the private bus services, it becomes clear that the decline in passenger transport on road is far less than with the railways.

In 1995, there were still 75 state-run companies in the bus transport sector of Azerbaijan. The fleet consisted of 3,728 vehicles with an average age of about 8 years. The vehicle stock is in an altogether bad technical condition.

The state bus companies offer connections on numerous routes both in long-haul and international traffic. In 1996 for instance, there was a daily service Baku-Tbilisi and five departures per day from Baku to Makhachkala (Dagestan). And there are a great many bus connections being offered by private Azerbaijan and, to a growing extent, also foreign companies.

In rail traffic, the number of passengers fell to 45.9 per cent from 1989 to 1995. The passenger transport performance was reduced to 38.7 per cent during the same period of time. There was a further sharp decrease in 1996, when the number of passengers dropped by another 50 per cent as compared to the previous year.

Tab. 2.2.1-32: Rail passenger traffic of Azerbaijan

	1989	1991	1993	1994	1995
Rail, total					
1,000	19,600	15,700	9,800	10,600	9,000
'000 000 pkm	2,042.9	1,975.2	1,395.8	1,111.9	791.2
Ø km	104	126	142	105	88
Regional traffic					
1,000	14,000	10,300	6,100	7,800	6,400
'000 000 pkm	177.0	181.8	171.3	170.1	140.2
Ø km	12.6	17.7	28.1	21.8	21.9
Long-haul traffic					
1,000	5,600	5,400	3,700	2,800	2,600
'000 000 pkm	1,865.9	1,793.4	1,224.5	941.8	651.0
Ø km	333	332	331	336	250

The number of passengers transported has declined more or less at the same rate in regional as well as long-haul traffic. Thus, the proportion of regional traffic in passengers transported remained more or less the same at approx. 71 per cent in 1995, as compared to 1989. The share of regional traffic in passenger transport performance rose from 8.7 per cent in 1989 to 17.7 per cent in 1995. This is due to the considerable shrinkage of the average transport distance in long-haul traffic from 333 km to 250 km.

The following table depicts passenger transport on selected main lines of the Azerbaijan Railways:

Tab. 2.2.1-33: Rail passenger transport on main lines in Azerbaijan

('000)

	1989	1994	1995
Baku - Tbilisi v.v.	525.6	160.6	22.0
Baku - Yalama v.v.	1,333.3	182.5	146.0
Baku - Nakhichevan v.v.	871.2	-	-
Baku - Astara v.v.	306.6	328.5	233.6

Due to the Nagorno-Karabakh conflict, operations were ceased on the line of Baku - Nakhichevan in March 1992.

Georgia

Georgia experienced the greatest drop in passenger transport among the three Caucasus republics. Both in the railway and the state bus services, the number of passengers transported as well as the transport performance fell to less than a quarter from 1989 to 1995.

Tab. 2.2.1-34: Passenger transport in Georgia

	1989	1991		1993		1995	
	'000 000	'000 000	% to '89	'000 000	% to '89	'000 000	% to '89
Rail	17.0	11.0	64.7	8.1	47.6	3.7	21.8
Bus	772.7	613.3	79.4	57.3	7.4	57.0	7.4
Air	2.7	2.4	88.9	0.6	22.2	...	...

The details on the bus services also contain the urban public transport. There are no official figures for private road transport for Georgia either. According to expert estimates, the share of the state sector in passenger transport was approx. 30 to 40 per cent in 1995.

In rail traffic, passenger transport dropped to 22 per cent from 1989 to 1995. In 1996, too, the downward trend continued. According to preliminary figures, the number of passengers transported fell by roughly another 10 per cent as compared to the previous year.

Tab. 2.2.1-35: Rail passenger traffic of Georgia

	1991	1992	1993	1994	1995
Rail, total					
1.000	11,041	7,632	8,070	9,762	3,676
'000 000 pkm	2,135	1,213	1,003	1,165	371
Ø km	193.4	173.4	131.0	120.5	101.4
Regional traffic					
1.000	6,219	4,654	5,642	8,449	3,010
'000 000 pkm	294.0	262.3	447.0	784.3	241.4
Ø km	47.3	56.4	79.2	92.8	80.2
Long-haul traffic					
1.000	4,822	2,978	2,428	1,313	666
'000 000 pkm	1,841	951	556	381	130
Ø km	382	319	229	290	195

The increase in the average transport distance in regional traffic and thus in its proportion of the total transport is obviously caused by the different allocation to the individual traffic sectors. The share of international traffic in the number of passengers transported in long-haul traffic was 22 per cent in 1989 and went down to 2 per cent in 1995.

2.2.1.7.3 Assessment of main factors of influence

Some of the decisive factors of influence were already described in sections 2.2.1.2 - 2.2.1.4 on the freight traffic forecast, e.g. the political and macroeconomic situation and foreign trade. That is the reason why only those aspects shall be elaborated on in the following which have direct influence on passenger traffic demand as well as the development of the modal split.

Political situation

The great number of conflict points in the Caucasus region has also led to serious impediments of national and international passenger traffic in all three countries. International rail traffic is especially hard hit. Lines which were formerly of great significance for rail passenger traffic are now either interrupted or only to be used to a severely restricted extent.

For instance, the Baku - Yalama - (Makhachkala) line is only used very little for passenger traffic because of the tense situation in the Northern Caucasus (Chechnia, Dagestan). Nearly 50 per cent of the total international passenger traffic of the Azerbaijan Railways was conducted via this relation in 1989. Passenger traffic on this section had gone down to 11 per cent of the 1989 level by 1995 and afterwards the international traffic was suspended generally. In October 1996, the regular scheduled service on the Baku - Makhachkala line was to be resumed once more, but had to be cancelled again only a few days later.

The line of Tbilisi - Samtredia - Sukhumi - (Russia) which was important for international passenger traffic in the past is not serviceable at the moment due to the conflict of Abkhasia. The important connections of Baku - Nakhichevan - (Armenia) and Yerevan - Nakhichevan - (Azerbaijan) are also shut down because of the Nagorno-Karabakh conflict.

Thus, the prospects for domestic long-haul traffic and international traffic of the railways in all three countries will be decisively influenced by the further political development in the region. In the scenarios described in section 2.2.1.7.4, assumptions are detailed as to the point in time of a possible resumption of international passenger traffic on the individual line sections.

Economic situation

The current economic situation in the three countries as well as possible scenarios for the further macroeconomic development for all three Caucasus republics have already been laid down in the section on the freight traffic forecast. Thus, the trough of the economic crisis connected with the transition to market economy structures has already been reached or overcome in all three countries. There is a moderate economic upswing with growth rates differentiated according to the respective country.

The macroeconomic development is of course closely linked to the factors of influence investigated in the following, such as the development of income, the rate of employment, individual car ownership.

And it is the degree of privatisation achieved so far which is of significance for the modal split in passenger traffic, as especially the road transport business is to undergo a transition to private economic structures. The three countries have meanwhile reached a different stage of privatisation. Armenia has progressed farthest, whereas in Azerbaijan the privatisation of small and medium-sized companies has just begun.

A privatisation of the state-owned railways is not planned in any of the three countries at the moment.

Development of income; rate of employment

The economic restructuring in the three countries has also led to dramatic changes in the development of the income, the structure of expenditure and thus in the cost of living for the population. The following table shows the development of prices for the period of 1990 to 1994 in Azerbaijan and Georgia:

Tab. 2.2.1-36: General retail price index (1990 = 1)

	1991	1992	1993	1994
Azerbaijan	2.1	20.9	257.1	4534.2
Georgia	1.75	15	478	28319

Also after inflation adjustment, there is a clear increase in the cost of living. The following example for Armenia shows that the real income has been drastically reduced over recent years:

Tab. 2.2.1-37: Money income of Armenia's population

	1990	1991	1992	1993	1994
disposable money income (in per cent, compared with previous year)	85.4	70.2	30.4	51.7	50.7

The situation in Azerbaijan and Georgia is similar.

The service sectors of the three countries are also hit by the increase in consumer prices.

Population

Population and population density figures are shown in the following table:

Tab. 2.2.1-38: Population and population density (1994)

	Population ('000)	Population density (per km²)	Share of urban population (in %)
Armenia	3754	133.5	67.7
Azerbaijan	7487	86.0	53.0
Georgia	5430	77.9	55.7

More than 50 per cent of the total population in Azerbaijan and Georgia live in towns and cities, 23 per cent of the people inhabit in the country's capital respectively. The proportion of the urban population in Armenia is about 67 per cent, some 35 per cent of the people live in the capital city of Yerevan.

Population figures and territorial distribution are strongly influenced by migration processes in all three countries. As a consequence of political conflicts, there is a relatively high number of refugees, who are temporarily living in the capitals or other large cities. Especially economic problems but also the tense political situation have led to the fact that a great number of people are leaving the region.

Foreign trade

A detailed discussion of the foreign trade relations of the three countries can be found in section 2.2.1.4 of the freight traffic forecast. It is especially the geographical structure of the foreign trade relations which is of relevance for the passenger traffic. Intensive mutual economic relations also lead to an increased business travel.

The relations between the three countries are of special significance for the rail traffic. Rail transport is less interesting for trips of business partners to other countries outside the region because of the great distances or difficult infrastructural conditions. The main means of transport for business trips from outside the region will be undoubtedly the aeroplane in future.

At the moment, the foreign trade relations within the region have not reached the level which would correspond with the potentials and possibilities of the countries. The causes are to be found first and foremost in the political tensions in the region but also in the yet not unfinished process of restructuring the economic and trade relations. Foreign trade relations among the three countries will intensify over the next few years.

Tourism

Tourism could become a growth potential for rail traffic in the region. However, the prospects are not very promising due to the political and economic relations in the short- and medium term.

The political tensions have caused tourist regions formerly significant for the populations of the three countries, for instance the Abkhasian Black Sea coast, Nagorno-Karabakh etc., to be rendered inaccessible. In addition, the infrastructure of the tourist sector has been badly affected by the military conflicts and the difficult economic situation in the countries.

Tourist traffic has decreased extremely as compared to the level of 1989 in all three countries. This is true for the following areas:

- the influx of foreign tourists, especially from the other CIS republics, has dropped to a minimum; trips to the three countries concentrate especially on the capital cities and less on the former traditional tourist resorts;

- holiday trips of the indigenous population within the own countries or the neighbouring countries more or less do not take place anymore; the main cause is above all the difficult economic situation, but also the political tensions in the region exert a negative influence;

Due to the new political framework, the relatively low number of trips abroad by the national populations are mostly undertaken to such countries, for which rail traffic is not interesting because of infrastructural conditions, distances or the costs involved (Iran, Turkey, Southern and Western Europe)

The steep decline in tourism is to be highlighted in the following with the help of Georgia as an example:

Tab. 2.2.1-39: Tourism in Georgia

(,000)

	1988	1989	1995
Tourists, total	1600	1005	252
including from			
Georgia	400	240	199
CIS	900	555	31
other countries	300	210	22

In future, the main means of transport for tourists will be the aeroplane. The railways will be used especially for trips within the region, e.g. to the tourist areas of the Black Sea coast. However, there is to be assumed a quickly growing significance of bus services, especially in the tourist sector. Already today, there are a great number of tourist offers by bus, which are conducted also covering extraordinarily large distances.

Individual car ownership

Armenia and Georgia belong to the republics of the former Soviet Union with the highest per capita car ownership, in Azerbaijan the stock of cars was under the Soviet Union's average.

Tab. 2.2.1-40: Car ownership

	1990		1995		1995/1990
	cars	per 1000 inhab.	cars	per 1000 inhab.	%
Armenia	240,800	67.4	256,700	71.8	106.6
Azerbaijan	246,000	34.2	392,165	52.4	159.4
Georgia	471,300	86.3	415,389	76.5	88.1

In comparison to Western Europe and also to other East European countries the level of individual car ownership is extremely low. The stock of private cars features a very high average age and is in a bad technical condition.

Based on the forecast of the economic development of the countries and the connected income situation of the population, only a slow increase in private car ownership is to be expected for the years to come. From 1990 to 1995, the stock of cars in Armenia only rose slightly (by 6.6 per cent) and in Georgia it even dropped (by 11.9 per cent). In Azerbaijan, the number of registered cars increased by nearly 60 per cent during the same period of time, but the car density of 52.4 vehicles per 1,000 inhabitants was still quite clearly below the level of the other two countries. Second-hand cars make up a relatively high proportion of imported cars at the moment.

2.2.1.7.4 Future traffic volumes

2.2.1.7.4.1 Total rail passenger transport

The individual factors of influence were first analysed and then their significance for the development of passenger volumes was assessed. A weighting of the individual elements was conducted, taking into consideration the respective specific factors in the individual countries.

The forecast of the volume in passenger traffic was based on the following general political and economic development in the region:

The internal political situation in all three countries will remain more or less stable over the next few years and will have a relatively insignificant influence on the number of passengers. The political situation in the region as a whole is of much greater importance, as this is what the development of international rail traffic but also national domestic long-haul traffic depend on. As regards the re-introduction of rail passenger traffic on the main lines, the two scenarios are based on the following development:

Relation	*optimistic*	*pessimistic*
re-introduction of passenger transport on the Tbilisi - Yerevan line	1998	2000
regular traffic Baku - Yalama - (Makhachkala/ Russia)	1997/98	2000
re-introduction of rail traffic via Nakhichevan	2000	2005
unimpeded rail traffic through Abkhasia	2000	2003

Azerbaijan

In Azerbaijan, too, the modal split will continue to shift in favour of transport by road. The total traffic volume will continue to decrease until 1997 and only slightly rise as of 1998. In railway traffic, a growth in passengers transported may be reckoned with as of 1998 at the earliest (optimistic scenario), but an increase is more likely only after the year 2000.
The assessment of the individual factors of influence yields the following growth rates in the passenger traffic of the Azerbaijan Railways (in per cent):

Tab. 2.2.1-41: Annual growth rates of rail passenger traffic in Azerbaijan

	1997	1998-2000	2001-2005	2006-2010	2011-2015
Regional traffic					
optimistic	-5.2	2.5 ... 5.0	4.8 ... 5.3	5.0	2.7
pessimistic	-25.0	-4.5 ... -5.0	0 ... 2.5	2.5 ... 2.7	1.0
Domestic traffic					
optimistic	-4.8	2.5 ... 5.0	9.5	4.6 ... 5.2	2.3 ... 2.7
pessimistic	-10.0	-2.8 ... 0.5	0 ... 5.6	2.6	1.0
International traffic					
optimistic	0	9.6 ... 10.2	14.5 ...15.4	9.4 ... 10.1	7.0 ... 7.5
pessimistic	0	4.5 ... 5.0	4.9 ... 5.5	4.5 ... 5.2	4.0 ... 4.8

In 1996, too, there was a significant reduction in the transport volumes of railway passenger traffic, amounting to some 50 per cent as compared to the previous year. This downward trend will continue also in 1997. Regional traffic is affected most severely by the reduction in passenger numbers. The share of this segment in the total number of passengers will go down to 57 per cent by 2015.

A growth in international traffic may be expected as of 1989 (optimistic scenario) or 2000 (pessimistic) with the normalisation of traffic on the Baku - Yalama - Russia line. A further increase will take place as of 2000 (optimistic) or 2005 (pessimistic) with the re-instatement of services to and through Nakhichevan. The start of operations on this line will also lead to a significant increase in domestic traffic.

As of 1997 the following average transport distances are expected:

Regional traffic	25 km
Domestic traffic	250 km
International traffic	295 km

This results in the passenger traffic volumes for the Azerbaijan Railways as shown in the table below.

Tab. 2.2.1-42: Rail passenger traffic in Azerbaijan up to the year 2015

(,000)

	1997	2000	2005	2010	2015
Passengers ('000)					
optimistic	4,333	5,205	7,316	9,396	10,717
pessimistic	3,644	3,292	3,928	4,457	4,709
Pkm ('000,000)					
optimistic	426.8	563.3	889.9	1,153.1	1,330.0
pessimistic	392.9	380.6	518.9	590.9	628.6

The detailed figures on the individual transport segments are contained in Annex 2.2.1-15.

The number of people transported in the optimistic version will rise to 119 per cent of the 1995 level by the year 2015, and in the pessimistic scenario the level is a mere 52 per cent of the 1995 figure. These large differences between the two scenarios result above all from the assumed repeated serious drop in the period of 1997/98 in the pessimistic scenario and the much later opening of important lines in long-haul traffic.

Georgia

In Georgia, the volume of the overall passenger traffic has risen since 1995 once more. However, the railways cannot profit from this yet, even in 1997. Thus, in Georgia, too, there will be a further increase in the proportion of road transport.

After the assessment and weighting of the individual factors of influence according to the specific conditions of the country, the following growth rates result for rail passenger transport in Georgia (in per cent):

Tab. 2.2.1-43: Annual growth rates of rail passenger traffic in Georgia

(,000)

	1997	1998-2000	2001-2005	2006-2010	2011-2015
Regional traffic					
optimistic	0	0.8 ... 3.0	3.2 ... 3.6	2.0 ... 2.5	2.2 ... 2.4
pessimistic	-5	-5.5 ... -2.3	0 ... 2.3	1.8 ... 2.0	1.5 ... 2.3
Domestic traffic					
optimistic	0	4.5 ... 5.3	4.8 ... 5.5	7.0 ... 7.5	5.0 ... 5.4
pessimistic	-2.6	-2.5 ... 0	2.4 ... 2.8	4.8 ... 5.0	2.1 ... 2.6
International traffic					
optimistic	2.5	7.1 ... 7.5	5.0 ... 5.3	9.5 ... 10.5	4.8 ... 5.0
pessimistic	0	0	2.1 ... 2.6	4.5 ... 5.3	1.8 ... 2.4

Impulses for an increase in the volume of Georgia's railway passenger transport will emanate from the re-instatement of services to and through Abkhasia. This applies both to the domestic long-haul as well as international traffic. A further increase of traffic will be linked with the start of traffic to Armenia.

The following average transport distances are assumed for the Georgian Railways as of 1997:

Regional traffic	45 km
Domestic traffic	185 km
International traffic*	75 / 210 km

* 210 km as of 2000/2003 (optimistic/pessimistic) with re-instatement of traffic through Abkhasia

As a result, passenger volume and passenger transport performance of the Georgian Railways will develop as follows until 2015:

Tab. 2.2.1-44: Rail passenger traffic in Georgia up to the year 2015

(,000)

	1997	2000	2005	2010	2015
Passengers ('000)					
optimistic	3,218	3,632	4,417	5,700	6,920
pessimistic	3,094	2,907	3,595	4,260	4,773
Pkm ('000,000)					
optimistic	348.4	412.4	516.5	715.6	897.3
pessimistic	337.7	320.5	449.1	550.1	620.2

In the optimistic scenario, the number of people transported will rise to 188 per cent of the 1995 level by the year 2015, and only to 130 per cent in the pessimistic version. These relatively high growth rates, compared with the other two countries, re-

sult, above all, from the comparatively low starting level in 1995, only 33 per cent of the 1991 level (Azerbaijan stood at 57 per cent and Armenia at 66 per cent).

In Georgia, the share of regional passenger transport will drop from 82 per cent in 1995 to 41 per cent in 2015 (optimistic scenario).

In order to check the forecast results achieved as to their plausibility, they were compared with the current situation in other European countries. Greece and Turkey suggested themselves as comparison, as their railway passenger traffic features a comparable initial situation. Both countries have a similar density of railway network as the three Caucasus republics. The degree of private car ownership is also comparable.

	Network density (km / 1,000 km^2)	Car ownership (cars / 1,000 inhab.)	Mobility (trips per year)
Turkey	10.8	43	2.2
Greece	18.8	178	1.2
Armenia	12.1	72	0.7
Azerbaijan	24.1	52	1.4
Georgia	52.7	77	1.3

The figures on network density and car ownership relate to 1995, mobility means trips by railway per inhabitant, for Greece / Turkey 1994, for the Caucasus republics in 2015 (optimistic scenario).

According to these figures, the three Caucasus republics will reach a similar level as regards the use of the railways for passenger traffic by the year 2015, as it currently prevails in Greece and Turkey.

2.2.1.7.4.2 Passenger transport in main railway corridors

The selection of the traffic relations, for which the passenger volumes are to be forecast, was based above all on the significance of the respective line sections for international traffic. The following relations were included in the assessment:

- Baku - Tbilisi
- Baku - Yalama - (Makhachkala)
- Baku - Nakhichevan - Yerevan
- Baku - Astara
- Tbilisi - Yerevan
- Tbilisi - Samtredia - Sukhumi - (Russia)

The forecast of the passenger volume related to the respective relation is difficult in so far as, except for the lines of Baku - Tbilisi and Baku - Astara, there is no scheduled passenger traffic at the moment. Thus, the identification of a realistic starting level is extremely complicated. In the following, the approach is explained in detail for each individual corridor.

Baku - Tbilisi

Over the past years, one international passenger train operated in each direction per day. The traffic volume has been decreasing steadily since 1989. The following passenger numbers were transported in the Baku - Tbilisi direction:

1989	262,000
1994	80,300
1995	10,950
1996	1,500

It is assumed that traffic on this line will be stabilised approximately at the level of 1995 as of the year 1998. The further development will then take place in line with the rates of increase established for international rail traffic. Thus, the following volume results for international passenger traffic on the Baku - Tbilisi v.v. line:

('000 passengers)

Baku - Tbilisi v.v.	1998	2000	2005	2010	2015
Optimistic scenario	22	27	54	86	124
Pessimistic scenario	17	19	24	31	39

Based on the transport volume of 1995 and the rates of increase as laid down in section 2.2.1.7.4, the volume of domestic long-haul traffic was established additionally for the relation Baku - Gyandsha v.v.:

('000 passengers)

Baku-Gyandsha v.v.	1995	1997	2000	2005	2010	2015
Optimistic scenario	803	465	526	847	1,081	1,223
Pessimistic scenario	803	441	419	509	576	606

Baku - Yalama - (Makhachkala/Russia)

In the past, this line was among the most important connections of the Azerbaijan Railways in international passenger traffic. The following number of passengers were transported in the relation of Baku - Yalama:

1989	666,650
1994	91,250
1995	73,000

The figures for 1989 include international traffic. As of 1994, the figures only relate to the passengers transported in domestic traffic. International traffic via Yalama to Russia was ceased due to the tense political situation. Already in 1996, traffic between Baku and Makhachkala was to have been re-introduced again. Now it is assumed that this connection will be operated regularly as of 1998 (optimistic) or 2000

(pessimistic). The predicted number of passengers in international traffic is 40,000 in the year of resuming operations. Thus, there would be the following passenger volumes for this section:

('000 passengers)

Baku - Yalama v.v.	1995	1997	2000	2005	2010	2015
Optimistic scenario						
Domestic long-haul	146	85	96	154	197	222
International traffic	-	-	48	97	157	225
Pessimistic scenario						
Domestic traffic	146	80	76	93	105	110
International traffic	-	-	40	51	65	83

Baku - Nakhichevan - Yerevan

Due to the conflict around Nagorno-Karabakh, railway operations were ceased on this line in March 1992. In the year 1989, some 525,600 passengers were transported between Baku and Nakhichevan, and the figure was 345,600 for the relation of Baku to Yerevan. The optimistic scenario assumes the resumption of traffic in the year 2000 (pessimistic scenario - 2005).

The following passenger volume is predicted for the time of resuming operations:

Domestic long-haul traffic	200,000
International traffic	30,000

The passenger numbers assumed for the domestic long-haul traffic (Baku - Nakhichevan) more or less correspond with the level of the entire domestic long-haul traffic in the year 2000, as compared to 1989.

Using the development rates detailed above, the following passenger numbers result for the Baku - Nakhichevan corridor (both directions):

('000 passengers)

Baku - Nakhichevan	1995	1997	2000	2005	2010	2015
Optimistic scenario	-	-	230	260	332	375
Pessimistic scenario	-	-	-	230	260	273

Baku - Astara

The passenger volume was established for this relation, based on the actual level in 1995, using the development rates for domestic long-haul traffic:

('000 passengers)

Baku - Astara v.v.	1995	1997	2000	2005	2010	2015
Optimistic scenario	234	136	171	275	351	397
Pessimistic scenario	234	128	122	170	192	202

Tbilisi - Yerevan

Railway passenger transport was ceased on this line in May 1995. The reasons were the severely decreased passenger numbers as well as the unstable security conditions along the line.

It is assumed that traffic between the two capital cities will be resumed again in 1998 (optimistic) or 2000 (pessimistic). The assumed passenger volume on re-introducing services is 30,000. On the basis of the rates of increase for international traffic the following development is predicted:

('000 passengers)

Tbilisi - Yerevan v.v.	1995	1997	2000	2005	2010	2015
Optimistic scenario	0	-	33	42	61	77
Pessimistic scenario	0	-	30	36	45	50

Tbilisi - Sukhumi - (Russia)

In the past, this line was of special importance both for national as well as international passenger traffic. In connection with the conflict around Abkhasia, railway services were ceased completely. In predicting the future passenger volume on this line, it was assumed that regular railway traffic to and through Abkhasia will be resumed in the year 2000 (optimistic) or 2003 (pessimistic).

The assumed starting numbers on resuming traffic are 130,000 passengers in domestic long-haul traffic (that corresponds with the level of traffic on the Tbilisi - Poti line in 1996/97) and 40,000 passengers in international traffic. Thus the following development of passenger traffic results up to the year 2015:

('000 passengers)

Tbilisi-Sukhumi v.v.	1995	1997	2000	2005	2010	2015
Optimistic scenario	0	0	170	217	320	409
Pessimistic scenario	0	0	0	209	261	295

Tbilisi - Samtredia - Poti / Batumi

These connections are also of significance for the tourist traffic and as a link to the two important port towns of Poti and Batumi. Unfortunately, there is no concrete statistical data available on the current passenger traffic on these lines. Thus the prediction was based on our own calculations, using the seat capacity being offered on these lines and the average passenger numbers carried on the trains (details provided by the Georgian Railways). The following passenger volumes result for 1995:

Tbilisi - Batumi v.v.	220,300
Tbilisi - Poti v.v.	130,800

Using the established growth rates for domestic long-haul traffic in Georgia, the passenger volume will develop as follows up to the year 2015:

('000 passengers)

Tbilisi - Poti v.v.	**1995**	**1997**	**2000**	**2005**	**2010**	**2015**
Optimistic scenario	131	131	152	194	278	355
Pessimistic scenario	131	126	120	174	217	246

('000 passengers)

Tbilisi - Batumi v.v.	**1995**	**1997**	**2000**	**2005**	**2010**	**2015**
Optimistic scenario	221	221	256	327	470	600
Pessimistic scenario	221	213	203	295	367	415

Annexes:

2.2.1-1 Geographical structure of Azerbaijan foreign trade
2.2.1-2 Geographical structure of Georgia foreign trade
2.2.1-3 Commodity structure of Azerbaijan foreign trade
2.2.1-4 Commodity structure of foreign trade of Georgia
2.2.1-5 Main export items of Azerbaijan
2.2.1-6 Main import items of Azerbaijan
2.2.1-7 Foreign trade between Azerbaijan and Georgia
2.2.1-8 Azerbaijan's exports of oil products
2.2.1-9 Development of rail freight traffic - Azerbaijan
2.2.1-10 Development of rail freight traffic - Georgia
2.2.1-11 Westbound traffic in Baku - Tbilisi - Poti/Batumi corridor (optimistic)
2.2.1-12 Westbound traffic in Baku - Tbilisi - Poti/Batumi corridor (pessimistic)
2.2.1-13 Eastbound traffic in Baku - Tbilisi - Poti/Batumi corridor (optimistic)
2.2.1-14 Eastbound traffic in Baku - Tbilisi - Poti/Batumi corridor (pessimistic)
2.2.1-15 Development of rail passenger traffic in Azerbaijan
2.2.1-16 Development of rail passenger traffic in Georgia

Final Report Module A

Chapter 2 Institutional, organisational and commercial pre-feasibility

2.2 Commercial pre-feasibility

2.2.2 Financial forecast

2.2.2 Financial forecast

2.2.2.0 Introduction

The following explanations and statements primarily contain the items determined in WP 1220 of the service offer. Apart from assessing the revenue (revenue forecast), this also includes, in an extended sense, the assessment of the cost and profit as well as an assessment of the development stage of the accounting system with regard to deducing possibilities of establishing components of a dynamic cost management.

This investigation was conducted with the help of cost, revenue and performance data made available by the two railways. The aim of this work was to derive decision-making aids for financing a pilot train for the speedy and safe transportation of high-quality goods in the relation of Baku - Poti/Batumi as well as further measures geared towards a re-establishment of a safe and reliable train operation service along this line.

As a result of negotiations with the representatives of the two railways of Azerbaijan and Georgia on the preparation of the joint work on this task, the wish was expressed to extend the scope of the project to include the drafting of documents acceptable to banks for the preparation of loan applications for targeted investment projects in connection with the above mentioned line. In accordance with this wish, the task was extended by an additional part of analysis and forecast regarding the financial situation of the two railways up to the year 2015, on the basis of a profit and loss account with integrated cash-flow statements.

2.2.2.1 Initial conditions

For a better assessment of the current financial situation of the two railways, it was necessary to link this with the assessment of the development stage of the accounting system. Only then was it possible to analyse and evaluate better the included ratios with regard to their factual contents. The results of the study 'Azerbaijan State Railways - Management and Organisational Structure - Final Report' /1/, drawn up by Nethconsult, were also evaluated within the framework of this investigation.

The cost, revenue and performance data of the two railways from 1995 served as initial data. Unfortunately, it was not possible to include detailed basis data from several previous years into this assessment because there were no data available due to major social changes which have taken place in both countries over the past few years. The effects of these changes on the financial situation are detailed in the following paragraphs. Only few selected ratios from 1994, which were not influenced directly by monetary assessment criteria, as for instance the transport performance, could be included in a comparison. Pertaining cost or revenue data for 1994 were converted into 1995 prices by the Azerbaijan and Georgian Railways and thus, they were made, at least approximately comparable to the 1995 cost situation

The current financial situation of the two railways is being influenced by two major factors. These are the disintegration of the former Soviet Union and the adopted path of the two state governments towards setting up instruments of a market-economy. The disintegration of the former state alliance of the Soviet Union led to military conflicts which had different effects on the transport performance and the organisational changes in the accounting system, depending on the situation and characteristic of the specific country.

Generally, the following statement can be made for the development of the transport performance and the financial situation of the two Trans-Caucasian railways:

1) The transport performance of 1995 was only a fraction of the 1989 performance

2) The decontrol of the formerly subsidised prices, e.g. for material, energy and repairs, as well as the re-valuing of the fixed assets, in conjunction with the devaluation of the currency, led to a cost explosion, which in turn resulted in an increase in the tariffs.

3) The dramatic decline in the transport performance, especially in freight traffic, brought about a significant reduction in the revenue of the railways.

4) The dissolution of the centralised system of distributing the revenue through the former Ministry of Railways of the USSR (MPS) in Moscow and the re-organisation of the revenue appropriation at each of the two railways led to revenue losses, which in turn had a negative influence on the inter-state payment transactions with other former states of the Soviet Union, as for instance, with Belarus and the Ukraine.

The organisational changes in the accounting system resulted, above all, from the dissolution of the former central structures of set rules and their replacement by decentralised structures. In former times, for instance, the methodological basis for the organisation of the accounting system, such as the structure of cost centres and cost types, charts of accounts, calculation guidelines and guidelines on the formation of prices, were all drawn up by the Ministry of Railways of the USSR (MPS), and these were then passed on to all railways for uniform application. The financing of investments as well as the capital cost of the infrastructure and the rolling stock, in other words, the entire fixed assets, were controlled by the MPS in a uniform manner.

After the abolition of these central structures and regulations, every railway had to find its own way to set up its accounting system according to the basic features of the market economy. Among other things, this applies to the following selected items:

- extending the structure of cost types, for instance by the capital cost of the fixed assets,

- setting up own (instead of former centrally-organised ones) funds (e.g. accumulation and amortisation fund) according to principles of the capital economy,
- developing tariff regulations and price formation rules,
- drawing up new regulations on the use of profits in connection with new stipulations of the tax legislation in the respective state.

The above mentioned changes had different effects on the profit and loss account and on the entire financial situation of the Azerbaijan and Georgian railways, and thus they have to be analysed separately for each of the two railways.

In order to deduce development trends in the financial situation, a trend assessment was drawn up for the transport performance (taken from /3/) as well as the cost and revenue up to the year 2015.

2.2.2.2 Assessment of the financial situation of the Azerbaijan and Georgian State Railways

2.2.2.2.0 Fundamental Approach

The investigations focused on two parts which are connected with each other in terms of content. The first part contains the assessment of the present accounting system and of the financial situation of the two railways, the second and far more comprehensive part deals with the forecast calculation for assessing the future, financial situation of the two railways up to the year 2015. These forecast calculations are based on the following prerequisites:

- Analysis of the actual cost in 1995, to create a normalised basis for the cost accounting to start from. This analysis of actual costs must be done prior to normalising the costs, because only this way the method to be used for normalisation and the height of the normalised cost level can be deduced.
- Elaboration and application of a dynamic cost-efficiency and profit model. This model became necessary in the first place to be able to assess the development of select cost groups in dependence of the forecast development of performances.
- Adjustment of the cost structures of the cost basis started from to the cost-per-formance-profit model. Above all, this means the division of
  - the total cost into cost of transport performance and costs other than transport performance costs. Such costs are, for instance, costs for hospitals, schools, kindergartens, sports facilities and public utilities. These costs are in no way connected with the development of the transport performance and are therefore not included in the calculations. Contrary to this present investigation, in the Joint Venture Study these costs are contained under the label "Side and Service Activities", in order to elaborate up-to-date evidence of balances for the bases of financing of one or more joint venture(s);
  - the costs of the transport performance into variable and fixed cost components, so to be able to describe the dynamic development of costs as compared to the change in performance.
- Creation of a special form for presenting the forecast calculation. For this purpose, a special form of profit and loss account was chosen (see Annexes 2.2.2-4, 2.2.2-5, 2.2.2-9, and 2.2.2-10).

Taking into account this procedure, a balance sheet was not drawn up since it cannot meet these requirements.

2.2.2.2.1 Azerbaijan State Railways

2.2.2.2.1.1 Basis and structure of the accounting system

The Nethconsult study already gave a lot of attention to the analysis of the basic principles and structures of the Azerbaijan State Railways' accounting. Within the framework of this work, further-going investigations are presented in this field, which are to serve, above all, a better understanding of the factual statements on the financial situation of the Azerbaijan State Railways. The analysis is conducted separately for the financial complexes of cost and revenue.

Registration and allocation of costs

Cost accounting of the railways within the former USSR was based on the guidelines and instructions of the MPS. These documents laid down the main allocation principles for cost-type accounting and cost-centre accounting and these had to be applied in a uniform manner by the individual state railways. The cost-unit accounting (application of calculation methods) was only geared towards few performance reference figures.
As the procurement, maintenance and separation of the entire fixed assets was the responsibility of the MPS, the capital cost of the fixed assets as well as the cost of major repairs was allocated at central level. The cost shares mentioned above were not a part of the cost accounting of the individual state railways and thus they had to be included into the new cost structures (see section 2.2.2.1) after the central regulations had been abolished.

The cost accounting of the Azerbaijan State Railways is subdivided into one centralised and three decentralised parts. This subdivision makes the realisation of the principles of cost-centre accounting possible. The three decentralised parts are the three_regions of Gyandsha, Baku and Nakhichevan, which are, in some respect, also regarded, to be the profit centres as far as the development of revenue and cost formation is concerned. The central part contains the indirect cost which is not to be allocated to the three parts individually and directly, as well as the cost of the Azerbaijan State Railways' management.

The costs and revenues are planned and accounted according to an annual plan. The monthly plan figures are up-dated as a result of the current accounting.

It is significant for the analysis of the costs to classify them according to their nature and genesis, i.e. to structure them in such a way that the principle of allocation the cost according to its cause is guaranteed. Furthermore, attention has to be focused on the comparability of the cost structure and the cost accounting of the Azerbaijan State Railways with other railways, e.g. with European railways. In order to meet these principles in this project, only the prime costs of railway operation were investigated, i.e. the pure transportation costs. Costs for hospitals, schools, kindergartens, sports and supply facilities owned and run by the railways were not included.

The prime costs (planned and actual figures) of the railways given for passenger and freight traffic in an annual overview are classified as follows:

- ❒ cost of passenger traffic, container traffic and commercial work incurred at stations,
- ❒ cost of tractive units,
- ❒ cost of wagons,
- ❒ cost of tracks,
- ❒ cost of construction,
- ❒ cost of signalling and telecommunication equipment,
- ❒ cost of energy supply,
- ❒ cost of breakdown trains,
- ❒ other overheads of the three territorial areas,
- ❒ railway administration cost (overheads of the railways' management).

The cost shares of the individual elements in the total cost are listed in Annex 2.2.2-1. Once the cost is differentiated according to the type of cost, the following selected types of cost are detailed explicitly in the annual cost overview:

- ❒ staff cost,
- ❒ cost of traction energy - for train operation,
- ❒ cost of repairs,
- ❒ cost of other energy consumption,
- ❒ other cost (including material cost and amortisation (depreciation).

The individual cost shares of these types of cost are given in Annex 2.2.2-2.

The staff cost in the cost overview in Annex 2.2.2-2 makes up only a share of the expenditure on staff, i.e. the prime cost does not include all staff costs. A share of the staff cost is financed from the profit. These peculiarities are discussed in more detail in chapter 2.2.2.2.1.2.

Registration and distribution of the revenue

Up until 1992, the revenue from the railway transport service was registered centrally in Moscow for all former states of the Soviet Union and distributed again among the railways according to a special procedure. This central registration and distribution system of the revenue was based on the following regulations:

- The tariffs were determined by the MPS for the entire network of railways.
- The transport service was paid by the customer for the whole journey at the departure station
- In case of payment difficulties with a customer, there was a clearing system whereby the government of the guaranteeing country paid the money to the railways for the transport service rendered.

This central regulation has been abolished step by step from the year 1992, at the initiative of the MPS. As a consequence, the Azerbaijan State Railways developed

payment difficulties towards their own state and other states in the period up to the introduction of their own new procedures for claiming payments and clearing the payments due to

- the loss of centrally allocated revenue from transport services,
- the (newly developed) insolvency of some transport customers in their own country and
- lacking revenue due to a decline in the transport performance.

These payment difficulties have not been overcome to the present day (compare also chapter 2.2.2.2.1.2).

Since May 1994, every country has been responsible itself for the ordering and payment of transport services. This regulation entailed the necessity of creating a methodological and legal basis which has been introduced at the Azerbaijan State Railways step by step since the beginning of 1995.

The annual overview of the revenue given in Annex 2.2.2-3 is structured as follows:

Revenue from freight transport
including revenue from transport services
including revenue from additional charges

Revenue from passenger traffic
including revenue from transport services
including revenue from seat reservations
including revenue from luggage transport
including revenue from mail transport.

There are the following remarks to be made about Annex 2.2.2-3:

The figure of the total revenue to the tune of 285,738.4 million Manat in 1995 is a plan figure which was established on the basis of the transport performance during that year. Due to the low solvency of the transport customers in freight traffic and the partially state ordered transports, for instance food and fuel transports, only 99,000 million Manat were actually received, so that the cash-flow statements of the profit and loss account are in contradiction to the plan figures. This problem is discussed in more detail in chapter 2.2.2.2.1.3.

2.2.2.2.1.2 Profit and loss account of the Azerbaijan State Railways

The calculation of the profit was conducted on the basis of the documents supplied by the Azerbaijan State Railways for the year 1995, according to the following procedure:
The sum of the prime cost (see Annex 2.2.2-2) was deducted from the plan figure of total revenue (see Annex 2.2.2-3). The result is the (gross) profit from the transportation process. This is then

- *reduced* by the loss through transport irregularities (e.g. cost resulting from transport accidents),

- *increased* by profits from ancillary and supporting activities (e.g. additional revenue through leasing of railway equipment, loading and unloading work, storage and other services of the railways),
- *reduced/increased* by (further) non-scheduled revenue/cost (e.g. by sanctions and fees such as siding rent, penalties for unclean freight wagons, sanctions for belated return of containers etc., from the catalogue of local and ancillary charges).

The thus derived balance-sheet profit is further
- *reduced* by contributions towards social welfare funds (i.e. money into pension and social care funds),
- *reduced* by payments to the state budget (i.e. taxes, comparable with the corporate tax in Germany).

The remaining profit is called available profit (in the classical profit and loss account, this would correspond with the net profit after tax, but before depreciation). The calculation of the profit for 1995 is summarised in the Azerbaijan currency of Manat (US$ 1 equals 4,400 Manat).

(in million Manat)	
Total revenue	285,738.4
- Total cost	- 130,385.5
Profit from transportation process	155,352.9
- Loss from transport irregularities	- 86.0
+ Profit from ancillary and supporting activities	+ 7,101.8
± Non-scheduled revenue/cost (e.g. sanctions)	- 9,364.8
Balance-sheet profit	153,003.9
- Contributions to social welfare fund (1 %)	- 1,530.0
- Payments to state budget (35 %)	- 53,018.0
Available profit	98,455.9

The available profit to the tune of 98,455.9 million Manat was mainly used for feeding two funds, the consumption fund and the accumulation fund, with the following shares:

- 56,576.5 million Manat, i.e. 57.5 per cent, for the consumption fund and
- 40,642.8 million Manat, i.e. 41.3 per cent, for the accumulation fund.

The remaining share of the profit (1.2 per cent) was used for other 'ends', i.e. for 'miscellaneous'.

The following expenses, among others, are covered from the consumption fund:

- wage cost and additional cost of labour
  (In 1995 for instance, a large proportion of the wage cost was not financed from the prime cost, but following an instruction by the Azerbaijan Government, from the profit. This regulation has been reversed, according to a press release dated 15th August 1996, in two stages, starting on 1st September 1996.)
- bonuses
- redundancy payments
- maintenance of sanatoriums
- material support for veteran soldiers and veteran families
- meal subsidies
- support for sports clubs.

The accumulation fund was used for instance for the following projects:

- financing of investments
- maintenance of company owned buildings
- financial support of agriculture
- material support for the engineers' organisation.

2.2.2.2.1.3 Discussing the results of the Azerbaijan State Railways' profit and loss account

Fundamental statements

On the complex of revenue

As mentioned already in chapter 2.2.2.2.1.2, the ratio of total revenue is a plan figure. In 1995 the transport performance in passenger and freight transport would have yielded a revenue to the tune of 285,738.4 million Manat, heeding the existing tariff situation. Due to the low degree of solvency among the transport customers, there was only a revenue of 99,000 million Manat, with the remainder being owed by debtors.
These debts, calculated cumulatively, reached a magnitude of 196,000 million Manat on 1st June 1996, which corresponds with a value of US$ 44.55 million.
At the beginning of 1997, the cumulative debts were quoted as US$ 35 million, thus, there is a downward trend in the increase of the debts amounted by the debtors with the Azerbaijan State Railways.

According to most recent information, it is planned in 1997 to settle US$ 20 million out of the US$ 35 million through the state budget, the remainder should be claimed from the transport customers. Thus the further assessments of the future financial situation are based on the assumption that the debts will have been settled by the end of 1997. This assumption has to be made as this is the only way how a normal assessment of the financial situation may be drawn up for a longer period of time (see chapter 2.2.2.2.1.5).

On the complex of cost

The above mentioned situation of permanent debts of the railways' transport customer debtors has led to recurring payment difficulties on behalf of the Azerbaijan State Railways which have been even worsened by the lack of a bank credit system. For instance, there were problems in the regular monthly payment of the wages for the staff. The employees were subsequently put on short-time work, the cost of energy consumption could not be paid regularly and the cost of the maintenance of the superstructure and the rolling stock could not be paid for as was necessary. Due to this situation, no spare parts could be bought for the infrastructure and the rolling stock. Reserves from the depreciations could not be transferred to the accumulation fund for purchasing new vehicles. This state of a permanent lack of funds led to further operational measures by the railways' management to cut costs. For instance, the wages and salaries of the staff were reduced and investment and maintenance programmes were halted.

This process of permanent lack of money is being confirmed by the following assessment of select cost types, according to Annex 2:

Staff cost

The compilation of prime costs of the Azerbaijan State Railways shows an amount of 4.0 million US$ for this cost type. This would match an average monthly wage of an employee in the transport sector (the calculation in this case assumed a total of 20,960 employees) of 15.9 US$. Only by adding the second part of the wage which is financed from the profit (about 6 million US$) the average monthly wage rises to 40 US$. Despite this normalisation of the cost assignment it can be assumed that this average wage does not even meet the requirements of a minimum standard of living.

A further, significant feature of the low wage level is the low percentage of only 13 per cent (without normalisation of the cost assignment), or 22 per cent (with normalisation) as compared to the overall cost.

Costs for repairs

These costs mainly consider repairs performed by third parties. They include also expenses for services and spare parts, which at present incur in foreign countries (e.g. Belorussia or Ukraine) and which originally were a part of the interstate payment transactions in the Soviet Union.
Because of the lack of money only few repair services could be made use of, and thus led to a level which does not offer the slightest chance for satisfactory maintenance.

Costs for depreciations

Originally, depreciations were not a part of the cost calculation of the Azerbaijan State Railways; they were being centrally cleared in Moscow.
Subsequent to the collapse of the confederacy of the Soviet Union it became necessary to expand the cost calculation by the items of the capital cost, i.e. depreciations and interest. At the same time this resulted in new costs which additionally worsened the economic result.

The evaluation of the fixed assets by the Azerbaijan State Railways resulted to be problematic, anyhow, since, for instance

- the proof of the fixed assets and their evaluation became extremely complicated because of the armed conflicts with Armenia (cutting off of partial networks, and shutdown of capacities);
- the age structure of the fixed assets is very high (low current value);
- each evaluation leads to additional cost and therefore was done only reluctantly.

Principally it can be said that since 1994 there have been numerous evaluations of the fixed assets which, with a view to the assessment of their value, resulted to be very contradictory. The depreciations themselves are being referred to the replacement value.
The depreciation rates themselves, put in per cent as compared to the replacement value, were subject to a large range of variations.
So the determination of depreciation costs was subject to multiple manipulations aiming at positively influencing the Railways' operating results. In the opinion of the expert, depreciations of the mobile fixed assets should principally be done on the basis of the replacement value, and depreciations of the immobile fixed assets on the basis of the construction value / production value.

Since an informative data base for this purpose was lacking, the expert as a first step made an estimate, based on the remaining book value of the fixed assets as estimated by the Railways and as needed for performing the present transport services. These estimates yielded calculated depreciations of about 3.3 million US$, which were also assumed to be normalised costs. With an annual depreciation quota of 3 per cent, this would correspond to a remaining book value of 110 million US$ which for the year 1995 possibly might also be assessed as replacement value.
This uncertainty as regards the estimate in the year 1995 as of 1997 to a large extent is eliminated in the forecast calculation, since, beginning at this date and deduced from the investment programme and the replacement values, more exact depreciations can be calculated.

Material costs

The material costs of about 1.3 million US$ as shown for the year 1995 represent a very low and unrealistic level. Looking at the insufficient technical condition of the infrastructure and of rolling stock, a high need for material and spare parts can be deduced which, however, cannot be covered because of the lack of money.

As unrealistic statements on business administration have resulted both as regards the complex of revenues and the complex of cost, and parts of the profit were used to finance some of the prime cost, the necessity arose to normalise the cost basis of 1995 for the forecast model. Normalised costs are such costs which would have resulted under normal conditions and which would have left enough leeway for deprecation and financing. This normalisation of prime cost is detailed in section 2.2.2.2.1.4, differentiated according to the respective types of cost.

Establishing ratios for analysing the current financial situation of the railways

A more detailed assessment of the current financial situation can be carried out with the help of financial unit ratios which express the connection between performance, cost, revenue and profit. These unit ratios, presented in the ratio form of money unit per performance unit, express the respective share of the cost and revenue (and in their mutual relationship also the profit) per performance unit.
Apart from the above mentioned effects, this deeper-going assessment also provides bases for normalising the cost, and together they form the preconditions for creating base values for the forecast calculation.

Furthermore, unit ratios can also serve as a decision-making aid for granting loans and for determining repayment conditions towards the creditor.

Performance ratios

The performance ratios are used as a reference basis for the cost and revenue in this analysis. Thus, all important correlation between the financial expenditure and its causes can be depicted.

The tariff ton kilometre in freight traffic and the passenger kilometre in passenger traffic are the most important performance ratios for the railways. The tariff ton kilometre (tkm) is calculated from the transport volume to be transported and the distance carried on average, the passenger kilometre (pkm) from the number of passengers to be carried and travelling distance on average.

To assess the current and future financial situation, the following transport performance in freight traffic (in the optimistic and pessimistic version) is assumed (according to the traffic forecast):

Ratio	1988	1994	1995	1997	2000	2010	2015
Freight transport performance, in million tkm (opt.)	41,895	3,276	2,409	2,879	8,805	13,004	15,253
Freight transport performance, in million tkm (pess.)	41,895	3,276	2,409	2,696	5,469	8,638	9,971

The passenger transport performance (pkm) is assessed according to the traffic forecast as follows in the optimistic and pessimistic versions:

Ratio	1989	1994	1995	1997	2000	2010	2015
Passenger transport performance in million pkm (opt.)	2,042	1,104	787	427	563	1,153	1,330
Passenger transport performance in million pkm (pess.)	2,042	1,104	787	393	381	591	629

Cost

Two ratios are formed to assess the prime cost necessary for the transport_services that is to say cost per passenger kilometre (pkm) and cost per tariff ton kilometre (tkm). At first, they are calculated in the national currency of Manat, and later, in the summarising overviews of the annexes (see Annexes 2.2.2-4/5), they are converted to US$.

The following figures result for 1994 and 1995:

Ratio		1994	1995
Tariff ton kilometre	mill. tkm	3,276.20	2,408.50
Passenger kilometre	mill. pkm	1,103.80	786.90
Prime cost freight traffic	mill. man.	139,758.00	102,743.80
Prime cost passenger traffic	mill. man.	38,774.00	27,641.70
Unit cost freight traffic	man./tkm		42.66
Unit cost passenger traffic	man./pkm		35.13

The specific cost established for 1994 and 1995 are the same. This does not correspond to reality; it is, however, due to the fact that the cost of 1994, as already mentioned above, were converted to the 1995 prices by the Azerbaijan State Railways.

These cost ratios are not applicable to a forecast calculation because of the highly inflationary development. Due to this situation, there is an added need to normalise the cost of 1995. The normalisation should also be conducted for 1994, but this is not possible as there is a lack of basic information.

Revenue

In order to assess the transport efficiency, the cost has to be balanced against the revenue. Revenue per passenger kilometre and revenue per tariff ton kilometre serve this purpose. The revenue is also calculated on the basis of the national currency at first. According to the explanations in chapter 2.2.2.2.1.1, the actual transport performance is the basis for calculating the revenue, not the payments received.

As already explained with the cost, due to the comparability of the revenues according to the price level of 1995 the specific revenue rates of 1994 and 1995 would be more or less equal, which is why here a comparison is not needed, either.

The following figures result for 1994 and 1995:

Ratio		1994 at price level of 1995	1995
Tariff ton kilometre	mill. tkm	3,276.20	2,408.50
Passenger kilometre	mill. pkm	1,103.80	786.90
Revenue from freight traffic			
Revenue from transport services	mill. man.	323,378.00	237,018.20
Revenue from additional charges	mill. man.	55,380.00	40,729.10
Total revenue	mill. man.	378,758.00	277,747.30
Revenue from passenger traffic			
Revenue from transport services	mill. man.	7,384.40	5,265.80
Revenue from seat reservation, luggage and mail transportation	mill. man.	3,801.10	2,725.30
Total revenue	mill. man.	11,185.50	7,991.10
Specific revenue freight traffic (total)	man./tkm		115.32
Specific revenue freight traffic (only transport services)	man./tkm		98.41
Specific revenue passenger traffic (total)	man./pkm		10.16
Specific revenue passenger traffic (only transport services)	man./pkm		6.69

Assessing the result

When comparing the unit cost and revenue, the following figures result for 1995:

Ratio	Cost (Manat)	Revenue (Manat)	Result (Manat)
Freight traffic			
Unit cost freight traffic	42.66/tkm	-	-
Unit revenue freight traffic (total)	-	115.32/tkm	+ 72.66/tkm
Unit revenue freight traffic (only transport services)	-	98.41/tkm	+ 55.75/tkm
Passenger traffic			
Unit cost passenger traffic	35.13/pkm	-	-
Unit revenue passenger traffic (total)	-	10.16/pkm	- 24.97/pkm
Unit revenue passenger traffic (only transport services)	-	6.69/pkm	- 28.44/pkm

The following conclusions may initially be deduced from these ratios:

1. Passenger traffic is a loss-making business, its unit cost for producing the transport performance is about 3.5 to 5 times higher than the specific revenue. On normalising the cost, the difference would be up to 5.3 to 7 times higher. Comparing the percentage of the absolute annual prime cost of passenger traffic with the percentage of the total cost for 1995, this is 21.1 per cent (comp. Annex 2.2.2-1). The percentage of revenue from passenger traffic, however, is a mere 2.8 per cent of the total revenue (comp. Annex 2.2.2-3).

   This difference between cost and revenue can be reduced both by the introduction of cost-oriented transportation tariffs (despite several price rises in the past) as well as by a more balanced relationship between the transport performance and the expenditure necessary for it (identifying and implementing rationalisation potentials as well as avoiding loss-making activities). Shifting transport capacities/ potentials (and if need be also of staff) from passenger traffic to freight traffic can contribute to reducing this difference in the future.

2. The relationship between the unit cost and the unit revenue in freight transport is precisely the opposite. The main reason for this is to be seen in the too low and not normalised costs (see section 2.2.2.2.1.3). If the normalised cost would be included, a proportion between cost and revenues of only 1:1.75 would result.

3. The tariff situation in freight traffic is characterised by the same conditions as passenger traffic, there are no cost-oriented tariffs on the basis of price calculation. The tariffs in freight traffic are divided into international tariffs (including transit tariffs) and domestic tariffs. The international tariffs are subject to international agreements and offer little opportunity of a flexible amendment by any one railway organisation. The domestic tariffs were stipulated by the MPS in former times and are still being used in these structures even today. State authorities draw up increment coefficients which are confirmed by the Cabinet of Ministers of the Azerbaijan Government, upon every price rise. The influence of the railways on amount and structure of tariffs is extremely small. Thus, every individual price for a transport service is beyond normal price calculation.

   The international tariff and the domestic tariff mainly contain the following factors which influence the amount of the fare and the carriage charge:
   - transport distance (digressive)
   - weight of cargo
   - type of goods
   - utilisation of wagon capacity
   - type of wagon group.

   These factors determine the specific revenue rate in money unit per tariff ton kilometre (see chapter 2.2.2.2.1.3). Goods of higher tariffs yield a higher value. This can be 4 to 5 times as high as that of a low tariff type of good (e.g. cotton or oil). This is a great possibility of changing the revenue rate through a targeted marketing strategy in the long-term.

   Apart from these tariff regulations, there is still a whole host of stipulations on granting discounts. The most important one dates from 13th May 1996. According to an agreement between the railways of Azerbaijan, Georgia , Turkmenistan and Uzbekistan as well as the Caspian Shipping Company, the transportation tariffs for these countries are to be reduced by up to 50 per cent in the scope of discounts.

   In conclusion, it has to be said that the Azerbaijan State Railways could positively influence the financial situation by cooperating in drawing up the tariffs in the following manner:
   - increased cooperation when working out tariffs mainly for domestic freight transport to make them more flexible
   - developing a price calculation for establishing cost-oriented transport fares and charges on the basis of a cost-unit accounting,
   - stepping up marketing to increase the specific rate of revenue per tariff ton kilometre by a determined consideration of the goods structure when offering their services to the customers.

Conclusions from the assessment of the profit and loss account

The results of the investigation may be summarised as follows:

1. The receivables from debtors (debts from transport customers) of the Azerbaijan State Railways were approximately US$ 45 million on 1st June 1996, at the moment, they are estimated at US$ 35 million. At present, efforts are being undertaken by the railways and the Azerbaijan Government aimed at more or less paying off these debts in 1997.

2. The receivables from debtors of the railways, together with the lacking revenue due to a decline in the transport performance and the collapse of the whole currency system have led to a complicated financial situation, which is affecting the whole operational process. The physical condition of the infrastructure is deteriorating permanently and the structure of the rolling stock is increasingly ageing. This situation can only be improved through a targeted investment policy to modernise the infrastructure and the rolling stock step by step. This, however, calls for loans, which can only be made available by foreign banks.

3. To secure the liquidity of the railways the introduction of a banking system seems to be useful.

4. The ordering function for transport services (this is being held by the Cabinet of Ministers of the Azerbaijan Government for important transport goods to secure certain supplies) is not coupled with the responsibility of paying for these ordered transport services. Thus, there is a discrepancy between ordering and paying for transport services, due to two levels of responsibility.

5. In order to secure payment of the transport service by transport customer, it is recommended to implement the system of advance freight payment more consistently. Simultaneously, the own responsibility of the Azerbaijan State Railways in the field of business administration has to be increased by implementing the principle, "Those who order transport services, shall also pay for them"

6. The accounting system of the Azerbaijan State Railways has to be developed further with regard to a higher degree of flexibility and dynamics. This further development should include setting up a functioning system of controlling, step-by-step as an instrument for modern cost management.

7. Cost-unit accounting is to be regarded as an important component of cost accounting. It is recommended to use this as the basis for a dynamic price calculation for fixing the tariffs.

2.2.2.2.1.4 Normalising the prime cost of the 1995 railway operation

A trend assessment which is based on the normalised cost, is conducted to forecast the financial situation of the railways up to the year 2015. Usually this cost base is developed from the normal cost accounting by working out the average costs from the actual cost of former accounting periods. Such a normal cost accounting cannot be conducted for the Azerbaijan State Railways, due to the social changes which have taken place. Instead, the attempt was undertaken to deduce a normalised cost status from the actual costs of 1995.

Normalised costs such are costs which would have developed under normal conditions and would thus have left enough leeway for depreciation and financing. At the same time, it was attempted to include the principle of cost truth as far as possible in deducing these normalised costs.

In cooperation with the Azerbaijan State Railways, normalised costs were deduced for the following types of cost (see Annexes 2.2.2-4/5) for 1995:

Type	Costs old version 1995 US$ 1,000	Normalised costs 1995 US$ 1,000
Staff cost	4,010.5	10,059.6
Cost of repairs	5,611.1	11,222.2
Material cost	1,274.0	3,822.1
Amortisation (depreciation)	1,719.4	3,310.3

By normalising the above mentioned types of cost, the total prime cost is increased as calculatory cost from US$ 29.6 million to US$ 45.4 million.
The normalising of prime cost is explained as follows:

Staff cost: The increase results most of all from the adjustment of the profit (see section 2.2.2.2.1.2 and 2.2.2.2.1.3)

Cost of repairs: The cost of repairs is increased by the share of unpaid services rendered by others, (e.g. for Belarus and the Ukraine). For instance, due to a lack of money, repaired engines could not be bought back from the above mentioned countries (compare section 2.2.2.2.1.3).

Cost of material: This increase is due to the fact that necessary spare parts for maintenance (self-participation) could not be paid for because of a lack of financial means.

Amortisation: The higher value of amortisation (or depreciation) results from a normalisation of the depreciation cost of the fixed assets which could not be foreseen to the necessary extent (compare section 2.2.2.2.1.3).

In Annexes 2.2.2-4/5 the costs are balanced against one another in their original and normalised form for the year 1995. The normalised cost forms the basis for the trend assessment of the financial situation up to the year 2015, given in Annexes 2.2.2-4/5.

2.2.2.2.1.5 Assessing the future financial situation of the Azerbaijan State Railways

Fundamental approach

The three complexes which are the transport performance, revenue from transportation services and prime cost of transportation services, were assessed individually and, at the end, they were interlaced in a profit and loss account, in order to assess the financial situation up to the year 2015. The calculation and composition of the individual figures are given in Annexes 2.2.2-4/5, in an optimistic and pessimistic version. The years 1995, 1997, 2000, 2010 and 2015 were chosen as basis years. The ratios stated in Annexes 2.2.2-4/5 relate to the respective year, that is to say, they are not cumulative figures.

The assessment of the transport performance in freight and passenger traffic was taken from the traffic forecast. These performance figures are also identical with the statements made in chapter 2.2.2.2.1.3 of this report.

The assessment of the revenue was deduced from the specific rate of revenue US$ per pkm in passenger traffic and from the specific rate of revenue US$ per tkm in freight traffic, which was always related to 1995 as the basis year. Necessary changes in the tariffs and the tariff structure which could also result from a more detailed goods-related estimation of the transport services are considered in establishing the average specific revenue. This rate is multiplied by the respective performance ratio of the basis year in order to arrive at the absolute revenue per year. All of this is based on the prerequisite that the structure of the types of goods in the tariffs system will not change considerably in future.

The assessment of the cost was conducted separately according to the main types of cost. The respective amount of cost in the following years was deduced from the normalised absolute cost of 1995. The results cf work package 1400 (see chapter 4), especially the additional costs for depreciation and repairs due to modernisation, are included in this assessment.

The assessment of the financial situation is based on the following main assumptions:

- The relationship between the national currency of Manat and the US$ is evaluated at the same rate throughout all the years at a conversion rate of US$ 1 corresponding to 4,400 Manat.

- The normalised cost status of 1995 is the basis for assessing the cost and prices. An inflation index of 2.5 per cent is applied to the following years.
- The financial assessment is based on the objective that the railways are to be developed into a private company (if need be with subsidy instruments in regional passenger traffic, as it is common practice in Germany for securing the existence of the service according to the regionalisation law in force in Germany at the present time).
- Interest payments on possible loans which could be granted to the railways in future (and which are also necessary), are not yet entered as cost in the profit and loss account, as the conditions (e.g. amount of the loan, repayment periods and conditions, interest rates and leeway for paying interest (interest free periods) etc.) are unknown at present. The ratio of 'own financing sources' in Annexes 2.2.2-4/5, however, demonstrates the amount of financial means which might be available for the repayment of loans for the respective period under observation.
- The amount of taxes to be paid to the state to the tune of 35 per cent, based on the balance-sheet profit, is kept the same throughout the period of investigation up until the year 2015.

Assessment of revenue in freight traffic

The unit revenue in freight traffic was 2.62 Cents per tkm in the year of investigation. This corresponds to a unit cost rate of 1.49 Cents per tkm. This cost ratio which at first glance seems to be efficient, however, has to be scrutinised more critically. When considering the very low average wages of the employees and the age structure of the fixed assets, despite the normalisation of the cost basis, which cannot include all these factors, it emerges that the cost share would have to be fixed at a considerably higher rate.
In order to implement the principle of self-financing (producing their own funds), measures should be taken in the long-term to increase the specific revenue rate. The increase of this rate should not only be reached by a rise in the tariffs, but it will also result from changes in the structure of the types of goods in freight transport. For instance, the share of high-tariff goods, such as cotton and high-value industrial products, will increase quickly in imports and transit traffic (see traffic forecast), at the same time, the average specific revenue rate will rise. The following table (taken from the tariff applicable to transit traffic both in exports and imports) shows the large scope of the individual tariffs for the different types of goods. The figures refer to the transportation of one ton of freight in the corridor Baku - Poti, relating to the section of the Azerbaijan State Railways (535 km).

Type of goods	Price in US$ for one ton on the entire line	Price in cents per tkm for one tkm
Oil and oil products	8.88	1.66
Fertilisers and paper	19.89	3.72
Industrial goods	24.65	4.61
Cotton	34.13	6.38

This scope makes clear that even with a large degree of discount, an increase in the unit rate of revenue is to be expected.

It is recommended that a rate of revenues amounting to 5.50 US-cents per tkm in 2015 be achieved as follows:

- 50 per cent of the increase by raising the tariffs, especially for higher tariffed goods. Thus the average rate of revenues of at present 2.62 US-cents would increase to 4.06 US-cents per tkm.

- 50 per cent of the increase by increasing, in relation to the overall transport performance, the percentage of the transport performance for higher tariffed goods.

  If, for instance, the transport of cotton and industrial goods (the above table shows that these are goods with higher prices per tkm) would be increased to 1,500 million tkm (of an overall performance of 15,235 million tkm), at an estimated average tariff rate of 7.75 US-cents (following the above rise of tariffs) per tkm, additional revenues of 116.2 million US$ would be achievable, which would correspond to 13.9 per cent of the total revenues in goods transport.
  An increased rate of revenues can also be reached by increasing the efficiency of the container traffic which also counts to high-tariffed goods.

Assessment of revenue in passenger traffic

The specific revenue in passenger traffic was 0.23 Cents per pkm in 1995 and this corresponded with a specific cost share of 1.21 Cents per pkm. This shows that passenger traffic is a loss-making business, the cause of this is that the railways have to fulfil civic and social obligations. The orientation of future price formation should be towards cost-oriented prices on the basis of price calculations.
It can be assumed that in order to improve the Railways' financial situation in 2015 one has to proceed from an average revenue rate of 10.00 US-cents per pkm. This corresponds to a value which at present in Germany results from tariff revenues in public transport alone. Taking into account that in European countries further sources of income of the railways are available in the form of subsidies in European countries (e.g. in Germany rail public transit is being subsidised from public funds), it can be suggested for the Azerbaijan State Railways to achieve 50 per cent of the projected revenue rate in the year 2015 by raising the tariffs (which would mean an average fare of 5 cents per pkm). The remaining 50 per cent of the revenue rate would have to be subsidised by the state, which would correspond to an annual amount of about 67 million US$ as of 2015 in the optimistic version. In Germany, rail public transport is at present being subsidised with annually 12 billion DM.

Assessment of staff cost

The assessment of staff cost has to be made in connection with the process of development undertaken by the national economy of Azerbaijan. That is the reason

for the hypothesis that the average wage of a railway worker will develop more or less within the national economic average. For the economic growth of Azerbaijan high rates are expected, beginning as of the year 2000, thus, one may assume an increasing national prosperity, which in turn justifies higher wages (and requires these).
Apart from these national economic aspects in the development of the wage levels, further factors, which influence the amount of staff cost, have to be taken into consideration. These are in particular:

- a reduction in the number of personnel by using rationalisation potentials and increasing the productivity,
- an increase in highly qualified work in the technical and service areas of the railways which will cause a higher wage expectancy.

These factors result in an increase in the share of wage cost in the overall prime cost, in order to eliminate the low-wage level step by step. The assumption is made that up until the year 2015, similar cost proportions may be achieved as with the average European railways.

When estimating the staff cost, their percentage in the total cost was also taken into account. Though this value was calculated to be 50.36 per cent in 2015, it is still far behind that in highly developed countries. In Germany, for instance, a percentage of 70 per cent is reached with DB AG [German Railways].

This comparison is to allow the conclusion that the development of staff cost can very well correspond to real Azerbaijan standards.

The management of the railways should have the opportunity to make their own decisions between the staffing levels and the increase of the average wage of an employee in connection with targeted investment activities. For instance, the following proportions could be imagined within the framework of the estimated staff cost in the optimistic version:

Ratio	1995	2000	2015
Staff cost (in '000 US$ per year)	10,059.6	80,000	280,000
Average wage of an employee US$ per year	480	4,000	18,700
Number of employees (only for transport services)	20,960	20,000	15,000

Cost of traction energy

The cost of traction energy was assessed separately for fuel and electricity. The cost was established according to consumption ratios depending on the development of

freight transport performance (this is the main factor of development). The development coefficients were assumed to be the same for fuel and electricity consumption.

The calculation of cost for traction energy in the forecast period takes into account an annual rise in prices for fuel and energy of 2.5 per cent.

Cost of repairs

The normalised cost for 1995 and the assessment of the necessary cost for repairs within the framework of work package 1400 /4/ formed the basis for the assessment. When assessing the cost, it was initially assumed that only the cost of outside services, i.e. of third parties, was shown in the repair field. In order to cover the future total requirements of repair, the cost share of the own services was increased, too. This increase applies mainly to material and staff cost.

Cost of other energy consumption

This cost contains expenditure for energy consumption on stations, in workshops and other facilities which is not necessary for the direct transportation in the form of transport energy, but nevertheless, also depends on the transportation process, in the final analysis. When assessing the cost, the assumption was made that it would develop proportionally to the respective growth rates of freight transport performance at a ratio of 1:3, as from the basis year, as only a share of the cost is actually directly related to the transport performance. The cost was assessed separately with regard to fuel and electricity, in this case too.

Other costs

This cost complex comprises the cost of material, the depreciation cost and the cost for miscellaneous items, in order to remain comparable with the basic cost structure. In assessing the development of the depreciation cost, based on the normalised depreciation cost of 1995 the percentages of the annual depreciations were added, which result from the initial values of the new investments according to chapter 4 (Financial Pre-feasibility). Supplementary to the above mentioned estimate the percentage in the total cost, which features the scope of modernisation, was used to further facilitate the assessment of all of the depreciations.

Assessing the overall situation

Optimistic version

It becomes clear from the profit and loss account for the optimistic version (see Annex 2.2.2-4, page 3) that their own funds will not suffice to finance the necessary investments according to WP 1400, up to the year 2000. This financial dilemma can

only be overcome by granting a long-term loan. The repayment should not start before a repayment-free period of five years, as only after this time, would there be sufficient financial means for annual instalments for refinancing from the net profit of the railways.

Pessimistic version

For assessing the pessimistic version, based on the optimistic version the following ratios were altered:

- passenger transport performance,
- goods transport performance,
- specific rate of revenues in passenger and goods transport,
- staff costs,
- costs for traction energy,
- repair costs,
- costs for other consumption of energy,
- material costs, and
- depreciations.

It becomes clear from the profit and loss account that the dramatic financial situation will reach its climax in 1997, with a loss of US$ 3.46 million before interest and tax. The railways will not be able any more to pay taxes. The reason for this is, above all, the increased permanent expenditure of repair and capital cost within the framework of modernisation according to /4/. This situation can only be balanced out with a drastic cost cutting or by granting a loan. The Azerbaijan State Railways could only start repaying the loan as of 2005 at the earliest.

The following section gives a summary of recommendations to improve the financial situation.

Summary of recommendations to improve accounting system and financial situation

Improvement of accounting system

The accounting system has to be modernised in a way that

- costs, revenues, and services are divided up according to 'planning' and 'post-accounting';
- costs, revenues, and services are divided up according to 'goods traffic', 'passenger traffic', 'workshops' and 'infrastructure';
- costs are compiled where they accrue (formation of cost centres like, e.g., passenger stations, goods stations and marshalling yards, container terminals; transport performance in passenger traffic; transport performance in goods traffic; lines, and others); the percentage of directly allocable costs has to be raised here.

- allocation of costs is done to so-called cost units. Cost units are, for instance, the following:
  * gross ton-kilometre
  * net ton-kilometre (goods traffic)
  * person-kilometre
  * train-kilometre
  * tractive unit service hour
  * train hour
  * train attendant hour
  * tractive unit kilometre.

  This allocation of cost to performance ratios also allows a more objective estimate of the investments to be needed or of any reduction of fixed assets, respectively (e.g. closing of lines, stations, or parts of the system).
- planning and results are compared monthly and that any deviations showing are analysed.

Furthermore, with a view to cost- and market-oriented pricing as an important contribution to an effective tariffing system, a modern price calculation method must be developed and introduced that can meet the conditions of changed market situations.

For introducing these tasks, the organisation of the accounting system has to be complemented by establishing a controlling system.

These changes can only be made assisted by the existing staff in the accounting department, since only they possess sufficient information as regards local peculiarities and historical stages of development in accounting.

Improvement of the financial situation

1. Assuming that the railway is to be made a self-sufficient enterprise, the average rates of revenue have to be raised to a normal level, which will also serve to pay the current costs of the investment programme to become necessary for the restoration and modernisation of railway operation.

   The specific revenues in goods traffic will be raised between 1995 and 2015 from 2.62 US-cents per tkm

   - to 5.50 US-cents per tkm in the optimistic version, and
   - to 4.50 US-cents per tkm in the pessimistic version.

   In accordance with section 2.2.5.2, 50 per cent of this rise of the specific revenue rate can be reached by increases in freight rates, especially for higher tariffed goods, and another 50 per cent by raising the performance percentage of higher tariffed goods in the overall performance. In case revenues would not increase, the loss in the pessimistic version for 2015, for instance, would amount to US-$ 133 million.

The specific revenues in passenger traffic will be raised from 0.23 US-cents per tkm

- to 10 US-cents per tkm in the optimistic version, and
- to 5 US-cents per tkm in the pessimistic version.

50 per cent of this rise could be reached, for instance, by an increase in passenger fares, and another 50 per cent by subsidies from the state.

If the revenue rate would not increase, this would result in the pessimistic version for 2015 in a loss in passenger traffic of US-$ 24 million, and the overall profits would be reduced by US-$ 54 million to 234 million.

2. Starting from an initial value of US-$ 10 million in 1995 for staff costs, according to section 2.2.5.4 these will be raised

- to US-$ 280 million in the optimistic version, and
- to US-$ 240 million in the pessimistic version.

If this value in the pessimistic version for 2015 were to be divided in two (as a result of rationalisation measures), the overall profits would increase from about 54 million US-$ to 174 million US-$. To improve the economic result for the 1997 to 2000 period, such rationalisation measures could contribute to improving the pessimistic version with a view to the net profit. Examples for rationalisation could be:

- concentration of staff on the core business;
- giving up system parts that do not directly contribute to the transport services on the main lines;
- rationalisation in the field of workshops, maintenance and repair;
- reduction of operational performances in passenger and goods traffic by increased utilisation of transport capacities.

3. Reduction of costs accruing from the investment programme.
These costs, which mainly comprise costs for repairs and the depreciations, represent a considerable burden, which shows in the two versions. This burden becomes particularly evident for the 1997 to 2000 period (and in future, up to about 2005), in which the investment rates are especially high. To improve the financial situation, in a first version the investment programme would have to be 'unburdened'. This could be done, for instance, by shifting the priorities and thus deferring the investment amount of 305 million US-$ for the 1997 to 2000 period and of 650 million US-$ for the 2000 to 2005 period to the respective following years.

Shifting of priorities would be imaginable, e.g., for rolling stock, the largest bloc of costs. For this purpose, repairs of locomotives and cars could be reduced, as could be the depreciations. Further possibilities would be:

- increase of the useful life of rolling stock and railway facilities;
- widening of repair cycles in terms of time;

- hiring (instead of purchasing) of rolling stock.

If, for instance, the cumulative investment amount of approx. 955 million US-$ for the 1997 to 2005 period could be reduced by 200 million US-$ (new ranking of priorities) and these investments could be made after the year 2005, this would result in an annual reduction of about 4 million US-$, which for both versions would mean a considerable improvement of the financial situation. Such a reduction could be achieved by

- concentrating the investments in the public transport way on those main lines only on which during the above mentioned period the transport performances as forecast will be produced;
- concentrating the investments in rolling stock only on those cars and locomotives which in the above period will be required for producing, under rationalised operational conditions, the transport performances as forecast.

2.2.2.2.1.6 Conclusions for the profit and loss account of the Baku - Beyuk-Kyassik line

In accordance with the task of this investigation of also developing decision-making aids for financing a pilot train from Baku to Poti/Batumi (border station Beyuk-Kyassik) and further measures for the restoration of a safe and reliable train service on this line, it is necessary to assess the financial situation of the Azerbaijan State Railways for this line on a pro rata basis.

As the accounting system of the Azerbaijan State Railways does not include any line-related performance, cost and revenue accounting, the respective shares in the total network had to be estimated with the help of experts of the Azerbaijan State Railways. The following assumptions were made:

- The performance shares (passenger and freight traffic) of this line in the total performance up to the year 1999 amount to: 80 %
- The performance shares (passenger and freight traffic) of this line in the total performance as of the year 2000 amount to: 60 %
- The figures of the unit cost and revenue rates are maintained as for the total network.

With the help of these assumptions, all figures for assessing the financial situation on this line can be deduced from the figures for the entire network.

2.2.2.2.2 Georgian State Railways

2.2.2.2.2.1 Basis and structure of the accounting system

The historical development in establishing the accounting system of the Georgian Railways has been similar to that of the Azerbaijan State Railways following the collapse of the former Soviet Union, and this may be taken from chapter 2.2.2.2.1.1. That is the reason why this part of the report only describes characteristics which either have to be assessed differently for the Georgian Railways or only apply to the Georgian Railways.

Registration and allocation of cost

The cost accounting of the Georgian Railways is divided into two decentralised and one centralised part. It is in this division that the principles of cost-centre accounting are implemented. The two decentralised parts are the two regions of Tbilisi and Samtredia. The central part contains indirect cost which is not to be allocated to these regions as well as the cost of the Georgian Railways' management.

It is significant for the analysis of the costs to separate them according to their nature and genesis, i.e. to structure them in such a way that the principle allocating the cost according to that what has caused them is secured. Furthermore, attention has to be focused on the comparability of the cost structures and cost accounting of the Georgian Railways with other railways, e.g. with European railways. In order to implement these principles within the scope of this project, only the prime cost of railway operation was studied, i.e. the pure transportation cost. Costs for hospitals, schools, kindergartens, sports and supply facilities owned and run by the railways were not included.

The prime cost of the railways is detailed in an annual overview of the planned and actual figures, with the following subdivision, separated according to passenger and freight traffic:

- ❒ cost of passenger traffic, container traffic and commercial work incurred at stations,
- ❒ cost of tractive units,
- ❒ cost of wagons,
- ❒ cost of tracks,
- ❒ cost of high rise constructions
- ❒ cost of safety installations and telecommunication equipment
- ❒ cost of energy supply,
- ❒ cost of breakdown trains,
- ❒ other overheads from the two regions
- ❒ railway administration cost.

The cost shares of the individual elements in the total cost are listed in Annex 2.2.2-6. Once the cost is differentiated according to the type of cost, the following selected types of cost are detailed explicitly in the annual cost overview:

- staff cost,
- cost of traction energy - for train operation,
- cost of repairs,
- cost of other energy consumption,
- other cost (including material cost and amortisation (depreciation)).

Annex 2.2.2-7 contains the individual cost shares of these types of cost.

Registration and distribution of revenue

The revenue forms a second component of the accounting system. In general, the development of the registration and distribution of the Georgian Railways' revenue can be compared with that of the Azerbaijan State Railways, as laid down in chapter 2.2.2.2.1.1.

The revenue is structured as follows in the annual overview and is detailed explicitly in Annex 2.2.2-8:

Revenue from freight transport
including revenue from transport services
including revenue from additional charges

Revenue from passenger traffic
including revenue from transport services
including revenue from seat reservations
including revenue from luggage transport

including revenue from mail transport.

2.2.2.2.2.2 Profit and loss account of the Georgian Railways

The calculation of the profit was conducted on the basis of the documents supplied by the Georgian Railways for the year 1995, according to the following procedure:
The sum of the prime cost (see Annex 2.2.2-7) was deducted from the plan figure of total revenue (see Annex 2.2.2-8). The result is the (gross) profit from the transportation process. This is then

- *reduced* by the loss through transport irregularities (e.g. cost resulting from transport accidents),
- *increased* by profits from ancillary and supporting activities (e.g. additional revenue through leasing of railway equipment, loading and unloading work, storage and other services of the railways),
- *reduced/increased* by (further) non-scheduled revenue/cost (e.g. by sanctions and fees such as siding rent, penalties for unclean freight wagons, sanctions for belated return of containers etc., from the catalogue of local and ancillary charges).

The thus derived balance-sheet profit is further

- *reduced* by payments to the state budget (i.e. taxes, comparable with the corporate tax in Germany).

The remaining profit is called available profit (in the classical profit and loss account, this would correspond with the net profit after tax, but before depreciation). The calculation of the profit for 1995 is summarised in the Georgian currency of Lari (US$ 1 equals 1.2 Lari)

The calculation of the profit for 1995 is carried out according to the following composition:

(in '000 Lari)	
Total revenue	46,709.7
- Total cost	- 32,647.4
Profit from transportation process	14,062.3
- Losses from transportation irregularities	- 975.6
+ Profit from ancillary and supporting activities	+ 2,597.6
± non-scheduled revenue/cost (e.g. sanctions)	+ 412.2
Balance profit	16,096.5
- Payments made to state budget	2,068.2
Available profit	14,028.3

The available profit to the tune of 14,028.3 thousand Lari was used for feeding the following three funds:

- 3,800.6 thousand Lari which amounts to 27.1 per cent for the consumption fund,
- 8,626.2 thousand Lari which amounts to 61.5 per cent for the accumulation fund and
- 1,601.5 thousand Lari which amounts to 11.4 per cent, for financing other objectives (miscellaneous)

The structure of the expenditure to be covered from these individual funds is analogous to the expenditure of the Azerbaijan State Railways (see chapter 2.2.2.2.1.2) except for wage payments.

2.2.2.2.2.3 Discussing the results of the profit and loss account

Fundamental statements

As already remarked for the Azerbaijan State Railways, due to the current financial situation and the civil war which took place in 1994, the financial statements of the

Georgian Railways on the 1995 cost calculation are unrealistic. This applies especially to the following cost types:

Staff cost
The compilation of prime costs of the Georgian Railways shows an amount of 6.7 million US$ for this cost type. This would match an average monthly wage of an employee in the transport sector (the calculation in this case assumed a total of 19,680 employees) of 28.5 US$. This low amount does not meet the requirements of a minimum standard of living. A further, significant feature of the low wage level is the low percentage of only 24.7 per cent (without normalisation of costs) as compared to the overall cost.

Costs for repairs
These costs mainly consider repairs performed by third parties. They include also expenses for services and spare parts, which at present incur in foreign countries (e.g. Belorussia or Ukraine) and which originally were a part of the interstate payment transactions in the Soviet Union. Because of the lack of money only few repair services could be made use of, and thus led to a level which does not offer the slightest chance for satisfactory maintenance.

Costs for depreciations
Originally, depreciations were not a part of the cost calculation of the Georgian Railways; they were being centrally cleared in Moscow.
Subsequent to the collapse of the confederacy of the Soviet Union it became necessary to expand the cost calculation by the items of the capital cost, i.e. depreciations and interest. This resulted in new costs which additionally worsened the economic result.
The evaluation of the fixed assets by the Georgian Railways resulted to be problematic, anyhow, since, for instance

- the proof of the fixed assets and its evaluation became extremely complicated because of the civil war (e.g. large-scale looting);
- the age structure of the fixed assets is very high (low current value);
- each evaluation leads to additional cost and therefore was done only reluctantly.

Principally it can be said that there have been numerous evaluations of the fixed assets. These, too, were subject to multiple manipulations aiming at positively influencing the Railways' operating results.

Since an informative data base for the evaluation of the fixed assets according to their replacements values was lacking, the expert made an estimate, based on the remaining book value of the fixed assets as estimated by the Railways and as needed for performing the present transport services. These estimates yielded depreciations of about 3.6 million US$, which were also assumed to be normalised costs. With an annual depreciation quota of 3 per cent, this would correspond to a remaining book value of 130 million US$ which for the year 1995 possibly might also be assessed as replacement value.

This uncertainty as regards the estimate in the year 1995 as of 1997 to a large extent is eliminated in the forecast calculation, since, beginning at this date and deduced from the investment programme and the replacement values, more exact depreciations can be calculated.

Material costs

The material costs of about 1.6 million US$ as shown for the year 1995 represent a very low and unrealistic level. Looking at the insufficient technical condition of the infrastructure and of rolling stock, a high need for material and spare parts can be deduced which, however, cannot be covered because of the lack of money.

The aforementioned estimated of selected cost types resulted in the necessity to normalise the cost basis of 1995 for the forecast model. Normalised costs are such costs which would have resulted under normal conditions and which would have left enough leeway for deprecation and financing. This normalisation of prime cost is detailed in section 2.2.2.2.2.4, differentiated according to the respective types of cost.

Establishing ratios for analysing the current financial situation of the Georgian State Railways

A more detailed assessment of the current financial situation can be carried out with the help of financial unit ratios which express the connection between performance, cost, revenue and profit. These ratios, presented in the ratio form of money unit per performance unit, express the respective share of the cost and revenue (and in their mutual relationship to the profit) per performance unit.
Apart from the above mentioned effects, this deeper-going assessment also provides indicators for normalising the cost (see section 2.2.2.2.2.4) and together they form the precondition for creating base values for the forecast calculation.

Furthermore, unit ratios can also serve as a decision-making aid for granting loans and for determining repayment conditions towards the creditor.

Performance ratios

The performance ratios are used as reference basis for the cost and revenue within the framework of this analysis. Thus, all important functional dependencies between the financial expenditure and this what has caused them can be shown.

The tariff ton kilometre in freight traffic and the passenger kilometre in passenger traffic are the most important performance ratios for the railways. The tariff ton kilometre (tkm) is calculated from the transport volume to be transported and the average transport distance, the passenger kilometre (pkm) from the number of people to be transported and the average travelling distance.

The assessment of the current and future financial situation is based on the transport performance (optimistic and pessimistic version) in freight traffic in tkm (according to the traffic forecast) as follows:

Ratio	1988	1994	1995	1997	2000	2010	2015
Transport performance freight traffic in mill. tkm (opt.)	12,591	954.7	1,246	1,319	3,238	5,191	5,940
Transport performance freight traffic in mill. tkm (pess.)	12,591	954.7	1,246	1,185	1,522	2,588	3,106

The performance in passenger traffic (pkm) is assessed according to the traffic forecast in the optimistic and pessimistic version, as follows:

Ratio	1989	1994	1995	1997	2000	2010	2015
Transport performance passenger traffic in mill. pkm (opt.)	2,790	1,165	371	348	412	716	897
Transport performance passenger traffic in mill. pkm (pess.)	2,790	1,165	371	338	321	550	620

Cost

Two ratios are formed to assess the prime cost necessary for rendering the transportation services, that is to say cost per passenger kilometre (pkm) and cost per tariff ton kilometre (tkm). At first, they are calculated in the national currency of Lari, and later, in the summarising overviews of the annexes (see Annexes 2.2.2-9/10), they are converted to US $.

The following figures result for 1994 and 1995:

Ratio		1994	1995
Tariff ton kilometre	mill. tkm	954.7	1,246.0
Passenger kilometre	mill. pkm	1,164.5	371.3
Prime cost freight traffic	'000 Lari		20,220.9
Prime cost passenger traffic	'000 Lari		12,426.5
Unit cost freight traffic	Lari/tkm		0.0162
Unit cost passenger traffic	Lari/pkm		0.0335

Revenue

In order to assess the transport efficiency, the cost has to be balanced against the revenue. Revenue per passenger kilometre and revenue per tariff ton kilometre serve this purpose. The revenue is also calculated on the basis of the national currency at first. The following figures result for 1994 and 1995:

Ratio		1994	1995
Tariff ton kilometre	mill. tkm	954.7	1,246.0
Passenger kilometre	mill. pkm	1,164.5	371.3
Revenue from freight traffic			
Revenue from transport services	'000 Lari	27,970.7	43,425.6
Revenue from additional charges	'000 Lari	1,001.2	2,659.0
Total revenue	'000 Lari	28,971.9	46,084.6
Revenue from passenger traffic			
Revenue from transport services	'000 Lari	398.3	605.4
Revenue from seat reservation, luggage and mail transport	'000 Lari	48.6	19.7
Total revenue	'000 Lari	446.9	625.1
Unit revenue freight traffic (total)	Lari/tkm	0.030	0.0370
Unit revenue freight traffic (only transport services)	Lari/tkm	0.029	0.0349
Unit revenue passenger traffic (total)	Lari/pkm	0.0004	0.0017
Unit revenue passenger traffic (only transport services)	Lari/pkm	0.0003	0.0016

Assessing the result

Balancing the specific cost and revenue against one another, the following results emerge for 1995[1]):

Ratio	Cost Lari	Revenue Lari	Result Lari
Freight traffic			
Unit cost freight traffic	0.0162/tkm	-	-
Unit revenue freight traffic (total)	-	0.0370/tkm	+ 0.0208/tkm
Unit revenue freight traffic (only transport services)	-	0.0349/tkm	+ 0.0187/tkm
Passenger traffic			
Unit cost passenger traffic	0.0335/pkm	-	-
Unit revenue passenger traffic (total)	-	0.0017/pkm	- 0.0318/pkm
Unit revenue passenger traffic (only transport service)	-	0.0016/pkm	- 0.0319/pkm

The following conclusions or considerations may initially be deduced from these ratios:

1. Passenger traffic is a loss-making business, its unit cost for the passenger transport performance is about 20 times higher than the specific revenue. On normalising the cost, this difference would even be 25 times as much. Comparing the percentage of the absolute annual prime cost of passenger traffic in the total cost related to 1995, this is 38.1 per cent (comp. Annex 2.2.2-6). The percentage of revenue from passenger traffic, however, is a mere 1.3 per cent of the total revenue (comp. Annex 2.2.2-8).

   This difference between cost and revenue can be reduced both by the introduction of cost-oriented transportation tariffs (despite several price rises in the past) as well as by a more balanced relationship between the transport performance and the expenditure necessary for it (identifying and implementing rationalisation potentials as well as avoiding loss-making activities). And the shift of transport capacities / potentials (and if need be also of staff) from passenger traffic to freight traffic can contribute to reducing this difference in the future.

[1] As the specific revenue per performance unit in passenger and freight traffic is comparable only with great difficulty due to the 1994 civil war, only the year 1995 is used in this balance.

2. In freight traffic, the proportion between the specific cost and the specific revenues (1:2.3), always relating to the tariff ton kilometre, is too high, the main reason for this being the too low cost (see section 2.2.2.2.2.3). If the normalised cost were included, a proportion between cost and revenues of only 1:1.8 would result.

3. Generally, one can say that the detailed prime cost is so low because necessary services such as repairs on the railway network and the rolling stock vehicles cannot be financed any more.

4. The tariff situation in freight traffic is characterised by the same conditions as passenger traffic, there are no cost-oriented tariffs on the basis of price calculation. The tariffs in freight traffic are divided into international tariffs (including transit tariffs) and domestic tariffs. The international tariffs are subject to international agreements and offer little opportunity for a flexible amendment by any one railway organisation. The domestic tariffs, as a second form of tariffs, were stipulated by the MPS in former times and are still being used in these structures even today. State authorities draw up increment coefficients which are confirmed by the Georgian Government, upon every price rise. The influence of the railways on the amount and structure of tariffs is extremely small. Thus, every individual price for a transport service is beyond normal price calculation.

   The international tariff and the domestic tariff mainly contain the following factors, which influence the respective price of transport :
   - distance carried (digressive)
   - weight of cargo
   - type of goods
   - utilisation of wagon capacity
   - type of wagon group.

   These factors determine the unit revenue rate in money unit per tariff ton kilometre (see section 2.2.2.2.2.3). Goods of higher tariffs yield a higher value. This can be 4 to 5 times higher than a low tariff type of good (e.g. cotton or oil). This is a great possibility of changing the revenue rate through a targeted marketing strategy in the long-term.

   Apart from these tariff regulations, there is still a whole host of stipulations on granting discounts. The most important one dates from 13th May 1996. According to an agreement between the railways of Azerbaijan, Georgia , Turkmenistan and Uzbekistan as well as the Caspian Shipping Company, the transportation tariffs for these countries are to be reduced by up to 50 per cent in the scope of discounts.

   In conclusion, it has to be said that the Georgian Railways could positively influence the financial situation by cooperating in drawing up the tariffs in the following manner:
   - increased cooperation when working out tariffs mainly for domestic freight transport to make them more flexible,

- developing a price calculation for establishing cost-oriented transport charges on the basis of a cost-unit accounting,
- stepping up marketing to increase the unit rate of revenue per tariff ton kilometre by a determined consideration of the goods structure when offering their services to the customers.

Conclusions from the assessment of the profit and loss account

The results of the investigation may be summarised as follows:

1. According to the documents made available on profit calculation and appropriation (comp. chapter 2.2.2.2.2.1), there should be approximately 8.6 million Lari (this, too, is a plan figure), which the Georgian Railways should have had at their disposal for accumulation purposes for 1996. These funds do not suffice to meet the future requirements of a normal investment activity. What makes the situation worse is that, in connection with the civil war, many railway installations were destroyed and robbed.

2. The political situation in Georgia together with the lacking revenue due to the decline in the transport performance and the disintegration of the whole currency system have led to a complicated financial situation, which is affecting the entire operational process. The physical condition of the infrastructure is deteriorating permanently and the age structure of the rolling stock is increasing. This situation can only be improved by a targeted investment policy to modernise the infrastructure and the rolling stock step by step. This, however, calls for loans which can only be made available by foreign banks.

3. To secure the liquidity of the railways the introduction of a bank credit system seems to be useful.

4. In order to secure payment of transport services by transport customers (cash-flow problems had developed here, too), it is recommended to implement a system of advance freight payment more consistently. Simultaneously, their own responsibility of the Georgian Railways in the field of business administration has to be increased by implementing the principle, 'Those who order transport services, shall also pay for them.'

5. The accounting system of the Georgian Railways has to be developed further with regard to a higher degree of flexibility and dynamics. This further development should include the step-by-step establishing of a functioning system of controlling as an instrument of modern cost management.

6. Cost-unit accounting should be regarded as an important component of cost accounting. It is recommended to use this as the basis for a dynamic price calculation for forming the tariffs.

2.2.2.2.2.4 Normalising the prime cost of the 1995 railway operation

A trend assessment, using a normalised cost basis, is conducted to forecast the financial situation of the railways up to the year 2015. This cost basis is usually developed as a result of a normal cost accounting, in which average costs are deduced from the actual cost of former accounting periods. Such a normal cost accounting cannot be conducted for the Georgian Railways, due to the social changes which have taken place. Instead, the attempt was undertaken to deduce a normalised cost status from the actual costs of 1995.

Normalised costs are such costs which would have developed under normal conditions and would thus have left enough leeway for depreciation and financing. At the same time, it was attempted to include the principle of cost truth as far as possible in deducing these normalised costs.

In cooperation with the Georgian Railways, normalised costs were deduced for the following types of cost (see Annexes 2.2.2-9/10) for 1995:

Type	Cost old version 1995 US$ 1,000	Normalised cost 1995 US$ 1,000
Staff cost	6,731.9	8,265.7
Cost of repairs	8,522.1	10,000
Cost of material	1,585.3	3,300.8
Amortisation (depreciation)	1,472.5	3,644.3

By normalising the above mentioned types of cost, the total prime cost is increased from US$ 27.2 million to US$ 34.1 million.

The normalising of prime cost is explained as follows:

Staff cost: This cost increases as a result of a higher requirement for maintenance (self-participation).

Cost of repairs: The cost of repairs is increased by the share of unpaid services rendered by others (e.g. for unpaid repairs of engines in Belarus and the Ukraine).

Cost of material: This increase is due to a higher demand for spare parts by maintenance (self-participation).

Amortisation: The higher value of amortisation (or depreciation) results from a normalisation of the depreciation cost of the fixed assets.

The costs are balanced against one another in their original and normalised form for the year 1995 in Annexes 2.2.2-9/10. The normalised cost forms the reference basis

for trend assessments of the financial situation up to the year 2015, stated in Annexes 2.2.2-9/10.

2.2.2.2.2.5 Assessing the future financial situation of the Georgian Railways

Fundamental approach

The three complexes which are the transport performance, revenue from transport services and prime cost of the transport services were assessed individually and, at the end, they were interlaced in a profit and loss account, in order to assess the financial situation up to the year 2015. The calculation and composition of the individual figures are contained in Annexes 2.2.2-9/10, in an optimistic and pessimistic version. The years 1995, 1997, 2000, 2010 and 2015 were chosen as years of reference. The ratios given in Annexes 2.2.2-9/10 relate to the respective year, that is to say, they are not cumulative figures.

The assessment of the transport performance in freight traffic was taken from the traffic forecast, the performance in passenger traffic was taken from the financial pre-feasibility. These performance figures are also identical with the statements made in chapter 2.2.2.2.2.3 of this report.

The assessment of the revenue was deduced from the unit rate of revenue US$ per pkm in passenger traffic and from the unit rate of revenue US$ per tkm in freight traffic, always relating to the basis year of 1995. Necessary changes in tariffs and the structure of tariffs, or such resulting from a detailed, goods-related estimation of the transport performance, are considered in establishing the average unit revenue. This rate is multiplied by the respective performance ratio of the basis year in order to arrive at the absolute revenue per year. All this is based on the prerequisite that the structure of the types of goods in the tariffs will not change considerably in the future.

The assessment of the cost was conducted separately according to the main types of cost. The respective amount of cost in the following years was deduced from the normalised absolute cost of 1995. The results of work package 1400 (see /4/), especially the additional depreciation and repair costs due to modernisation, are included in this assessment of the cost.

The assessment of the financial situation is based on the following main assumptions:

- The relationship between the national currency of Lari and the US dollar is evaluated at the same rate throughout all the years at a conversion rate of US$ 1 corresponding to 1.2 Lari.

- The normalised cost status of 1995 is the basis for assessing the cost and prices. An inflation index of 2.5 per cent is applied to the following years.

- The financial assessment is based on the objective that the railways are to be developed into privately run enterprises (if need be with subsidy instruments in regional passenger traffic, as it is common practice in Germany, at the moment, for securing the existence of the service according to the regionalisation law).

- Interest payments on possible loans which could be granted to the railways in future (and which are also necessary), are not yet entered as cost in the profit and loss account, as the conditions (e.g. amount of the loan, repayment periods and conditions, interest rates and interest free periods etc.) are unknown at present. The ratio of 'own financing sources' in Annexes 2.2.2-9/10, however, points out the scope of financial means available for repayment of loans for the respective period under observation.

- The amount of taxes to be paid to the state to the tune of 20 per cent, based on the balance-sheet profit, is kept the same throughout the period of investigation up until the year 2015.

Assessment of revenue in freight traffic

The unit revenue in freight traffic was 3.08 cents per tkm in the year of investigation. This corresponds to a unit cost rate of 1.35 cents per tkm. This gives initially the impression of an efficient cost ratio, however, this has to be scrutinised more critically. When considering the very low average wages of the employees and the ageing structure of the fixed assets, despite the normalisation of the cost basis which cannot include all these factors, it emerges that the cost share would have to be fixed at a higher rate.

In order to implement the principle of self-financing (producing their own funds) measures should be taken in the long-term to increase the unit revenue rate. Increasing this rate, one should not only look to a rise in tariffs, but it will also result from a changed structure of the types of goods in freight transport. For instance, the share of high-tariff goods, such as cotton and high-value industrial products, will increase quickly in imports and transit traffic, thus, the average specific revenue rate will rise. (compare also chapter 2.2.2.2.1.5, the evaluation of the types of goods can be conducted in the same way, due to similar tariff conditions).

It is recommended that a rate of revenues amounting to 5.50 US-cents per tkm in 2015 be achieved as follows:

- 50 per cent of the increase by raising the tariffs, especially for higher tariffed goods. Thus the average rate of revenues of at present 3.08 US-cents would increase to 4.29 US-cents per tkm.

- 50 per cent of the increase by increasing, in relation to the overall transport performance, the percentage of the transport performance for higher tariffed goods.

  If, for instance, the transport of cotton and industrial goods would be increased to 1,200 million tkm (of an overall performance of 5,940 million tkm), at an estimated

average tariff rate of 7.75 US-cents (following the above rise of tariffs) per tkm, additional revenues of 93 million US$ would be achievable, which would correspond to 28.5 per cent of the total revenues in goods transport.
An increased rate of revenues can also be reached by increasing the efficiency of the container traffic which also counts to high-tariffed goods.

Assessment of revenue in passenger traffic

The unit revenue in passenger traffic was 0.14 cents per pkm in 1995 and this corresponded with a specific cost share of 2.79 cents per pkm. This shows that passenger traffic is an enormous loss-making business, caused by the railways being obligated to fulfil civic and social services. The orientation of future price formation should be towards cost-oriented prices on the basis of price calculations.

It is assumed that in order to improve the Railways' financial situation in 2015 one has to proceed from an average revenue rate of 10.00 US-cents per pkm. This corresponds to a value which at present in Germany results from tariff revenues in public transport alone. Taking into account that in European countries further sources of income of the railways are available in the form of subsidies in European countries (e.g. in Germany rail public transit is being subsidised from public funds), it can be suggested for the Georgian Railways to achieve 50 per cent of the projected revenue rate in the year 2015 by raising the tariffs (which would mean an average fare of 5 cents per pkm). The remaining 50 per cent of the revenue rate would have to be subsidised by the state, which would correspond to an annual amount of about 45 million US$ as of 2015 in the optimistic version. In Germany, rail public transport is at present being subsidised with annually 12 billion DM.

Assessment of staff cost

The assessment of staff cost has to be seen in connection with the process of development undertaken by the national economy of Georgia. That is the reason for the hypothesis that the average wage of a railway worker will develop more or less within the national economic average.

The economic growth in Georgia is assessed with relatively high rates, beginning as of the year 2000, thus, one may assume an increasing national prosperity, which in turn justifies higher wages (and requires these).
Apart from this national economic aspect in the development of the wage levels, further factors, which influence the amount of staff cost, have to be taken into consideration. These are in particular:

- a reduction in the number of personnel by using rationalisation potentials and increases in productivity,
- an increase in highly qualified work in the technical and service areas of the railways, which will cause a higher wage expectancy.

These two factors result in an increase in the share of wage cost in the overall prime cost, in order to eliminate the low-wage level step by step. The assumption is made

that up until the year 2015, similar cost proportions may be achieved as with the average European railways.

When estimating the staff cost, their percentage in the total cost was also taken into account. Though this value for 2015 was calculated to be 44 per cent in the optimistic version, it is still far behind that in highly developed countries. In Germany, for instance, a percentage of 70 per cent is reached with DB AG [German Railways].

This comparison is to allow the conclusion that the development of staff cost can very well correspond to real Georgian standards.

The management of the railways should have the opportunity to make own decisions between the staffing levels and the increase of the average wage of an employee in connection with targeted investment activities. For instance, the following proportions could be imagined within the framework of the estimated staff cost in the optimistic version:

Ratio	1995	2000	2015
Staff cost ('000 US$ per year)	8,265.7	35,000	150,000
Average wage of an employee (US$ per year)	420	1,840	10,700
Number of employees (only transport services)	19,680	19,000	14,000

Cost of traction energy

The cost of traction energy was assessed separately for fuel and electricity. The cost was established according to consumption ratios depending on the development of freight transport performance (this is the main factor of development). The development coefficients were assumed to be the same for fuel and electricity consumption.

The calculation of cost for traction energy in the forecast period takes into account an annual rise in prices for fuel and energy of 2.5 per cent.

Cost of repairs

The normalised cost for 1995 and the assessment of the necessary repair expenditure within the framework of work package 1400 (see chapter 4) formed the basis for the assessment.
In assessing the cost, it was assumed initially that only the cost of outside services, i.e. of third parties, was shown in the repair field. In order to cover the future total requirements of repair, the cost share of the own services was increased, too. This increase applies mainly to material and staff cost.

Cost of other energy consumption

This cost contains expenditure for energy consumption on stations, in workshops and other facilities, which is not necessary for the direct transport process in the form of transport energy, but also depends on it. In assessing this cost, the assumption was made that it would develop proportionally to the respective growth rates of freight transport performance at a ratio of 1:3, as from the basis year, as only a share of the cost is actually directly related to the transport performance. The cost was assessed separately with regard to fuel and electricity, in this case too.

Other cost

This cost complex comprises the cost of material, the depreciation cost and the cost for miscellaneous items, in order to remain comparable with the basic cost structure. In assessing the development of the depreciation cost, based on the normalised depreciation cost of 1995 the percentages of the annual depreciations were added, which result from the initial values of the new investments according to chapter 4 (Financial Pre-feasibility).

Assessing the overall situation

Optimistic version

It becomes clear from the profit and loss account for the optimistic version (see Annex 2.2.2-9, page 3) that their own financial funds will not suffice to finance the necessary investments up to the year 2010. What is more, in 2000 there will be a negative profit, prior to taxes and interest, of -4.375 million US-$. This financial dilemma can only be overcome by granting a long-term loan. The repayment should be coupled with conditions to improve the business results and should not start before a repayment-free period of ten years, as only after this time, would there be sufficient financial means for annual instalments for refinancing from the net profit of the railways.

Pessimistic version

For assessing the pessimistic version, based on the optimistic version the following ratios were altered:

- passenger transport performance,
- goods transport performance,
- specific rate of revenues in passenger and goods transport,
- staff costs,
- costs for traction energy,
- repair costs,
- costs for other consumption of energy,
- material costs, and
- depreciations.

It becomes clear from the profit and loss account that the dramatic financial situation in 1997 will start with a negative profit, prior to taxes and interest, of -5.8 million

US-$ and that, up to the year 2015, this value will increase to -22.6 million US-$. The railways will no longer be able to pay taxes to the state. The reason for this is, above all, the increased current repair and capital cost within the framework of modernisation according to WP 1400. This situation can only be balanced out with an increased use of capital to rationalise the entire transport activities on the basis of a loan. Repayment conditions would have to be linked with drastic measures to reduce costs.

The following section gives a summary of recommendations to improve the financial situation.

Summary of recommendations to improve accounting system and financial situation

Improvement of accounting system

The accounting system has to be modernised in a way that

- costs, revenues, and services are divided up according to 'planning' and 'post-accounting';
- costs, revenues, and services are divided up according to 'goods traffic', 'passenger traffic', 'workshops' and 'infrastructure';
- costs are compiled where they accrue (formation of cost centres like, e.g., passenger stations, goods stations and marshalling yards, container terminals; transport performance in passenger traffic; transport performance in goods traffic; lines, and others); the percentage of directly allocable costs has to be raised here.
- allocation of costs is done to so-called cost units. Cost units are, for instance, the following:
  * gross ton-kilometre
  * net ton-kilometre (goods traffic)
  * person-kilometre
  * train-kilometre
  * tractive unit service hour
  * train hour
  * train attendant hour
  * tractive unit kilometre.

  This allocation of cost to performance ratios also allows a more objective estimate of the investments to be needed or of any reduction of fixed assets, respectively (e.g. closing of lines, stations, or parts of the system).
- planning and results are compared monthly and that any deviations showing are analysed.

Furthermore, with a view to cost- and market-oriented pricing as an important contribution to an effective tariffing system, a modern price calculation method must be developed and introduced that can meet the conditions of changed market situations.

For introducing these tasks, the organisation of the accounting system has to be complemented by establishing a controlling system.

These changes can only be made assisted by the existing staff in the accounting department, since only they possess sufficient information as regards local peculiarities and historical stages of development in accounting.

Improvement of the financial situation

1. Assuming that the railway is to be made a self-sufficient enterprise, the average rates of revenue have to be raised to a normal level, which will also serve to pay the current costs of the investment programme to become necessary for the restoration and modernisation of railway operation.

   The specific revenues in goods traffic will be raised between 1995 and 2015 from 3.08 US-cents per tkm

   - to 5.50 US-cents per tkm in the optimistic version, and
   - to 4.50 US-cents per tkm in the pessimistic version.

   In accordance with section 2.3.5.2, 50 per cent of this rise of the specific revenue rate can be reached by increases in freight rates, especially for higher tariffed goods, and another 50 per cent by raising the performance percentage of higher tariffed goods in the overall performance. In case revenues would not increase, the loss in the pessimistic version for 2015, for instance, would amount to US-$ 42 million.

   The specific revenues in passenger traffic will be raised from 0.14 US-cents per tkm

   - to 10 US-cents per tkm in the optimistic version, and
   - to 5 US-cents per tkm in the pessimistic version.

   50 per cent of this rise could be reached, for instance, by an increase in passenger fares, and another 50 per cent by subsidies from the state (see section 2.3.5.3).

   If the revenue rate would not increase, this would result in the pessimistic version for 2015 in a loss in passenger traffic of US-$ 21 million, and the overall profits would drop from about US-$ 2 million to -28 million.

2. Starting from an initial value of US-$ 8.2 million in 1995 for staff costs, according to section 2.3.5.4 these will be raised

   - to US-$ 150 million in the optimistic version, and
   - to US-$ 65 million in the pessimistic version.

   If this value in the pessimistic version for 2015 were to be divided in two (as a result of rationalisation measures), the overall profits would increase from about 2.0 million US-$ to 34.6 million US-$. To improve the economic result

for the 1997 to 2000 period, such rationalisation measures could contribute to improving the pessimistic version with a view to the net profit. Examples for rationalisation could be:

- concentration of staff on the core business;
- giving up system parts that do not directly contribute to the transport services on the main lines;
- rationalisation in the field of workshops, maintenance and repair;
- reduction of operational performances in passenger and goods traffic by increased utilisation of transport capacities.

3. Reduction of costs accruing from the investment programme.
These costs, which mainly comprise costs for repairs and the depreciations, represent a considerable burden, which shows in the two versions. This burden becomes particularly evident for the 1997 to 2000 period (and in future, up to about 2005), in which the investment rates are especially high. To improve the financial situation, in a first version the investment programme would have to be 'unburdened'. This could be done, for instance, by shifting the priorities and thus deferring the investment amount of 175 million US-$ for the 1997 to 2000 period and of 571 million US-$ for the 2000 to 2005 period to the respective following years.

Shifting of priorities would be imaginable, e.g., for rolling stock, the largest bloc of costs. For this purpose, repairs of locomotives and cars could be reduced, as could be the depreciations. Further possibilities would be:

- increase of the useful life of rolling stock and railway facilities;
- widening of repair cycles in terms of time;
- hiring (instead of purchasing) of rolling stock.

If, for instance, the cumulative investment amount of approx. 746 million US-$ for the 1997 to 2005 period could be reduced by 200 million US-$ (new ranking of priorities) and these investments could be made after the year 2005, this would result in an annual reduction of about 4 million US-$, which for both versions would mean a considerable improvement of the financial situation. Such a reduction could be achieved by

- concentrating the investments in the public transport way on those main lines only on which during the above mentioned period the transport performances as forecast will be produced;
- concentrating the investments in rolling stock only on those cars and locomotives which in the above period will be required for producing, under rationalised operational conditions, the transport performances as forecast.

2.2.2.2.2.6 Conclusions for the profit and loss account of the Beyuk-Kyassik - Poti/Batumi line

In accordance with the task of this investigation of also developing decision-making aids for financing a pilot train from Baku to Poti/Batumi (border station Beyuk-Kyassik) and further measures for the re-establishment of a safe and reliable train operation on this line, it is necessary to assess the financial situation of the Georgian Railways for this line on a pro rata basis.

As the accounting system of the Georgian Railways does not include any line-related performance, cost and revenue accounting, the respective shares in the total network had to be estimated with the help of experts of the Georgian Railways. The following assumptions were made:

- The percentage of the transport performance in the total performance (passenger and freight traffic) on that line up to the year 1999 amounts to: 75 %
- The percentage of the transport performance in the total performance(passenger and freight traffic) on that line as of the year 2000 amounts to: 60 %
- The figures of the unit cost and revenue rates are maintained as for the total network.

With the help of these assumptions, all figures for assessing the financial situation on this line can be deduced from the figures for the entire network.

Bibliography

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/3/ TRACECA Pre-investment Study and Pilot Train Baku-Tbilisi-Batumi-Poti Final Report on WP 1210 (Traffic volume forecast)

/4/ TRACECA Pre-investment Study and Pilot Train Baku-Tbilisi-Batumi-Poti Final Report on WP 1400 (Financial pre-feasibility)

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Chapter 3 Technical Pre-feasibility

Final Report Module A

Chapter 3 Technical Pre-feasibility

3.1 Track and Constructional works
3.1.1 Azerbaijan

3.1.1 Track and constructional works on Azerbaijan State Railways

3.1.1.1 Existing situation

The total network length of Azerbaijan State Railways (AGZD) is 2,952 km. The AGZD main track lines in service cover about 763 km double track and 1,280 km electrified track 3.3 kV DC. Side track length amounts to 1,500 km and there are 4,890 turnouts.

Track line Baku - border point to Georgia

As the AGZD part of the railway corridor from the Black Sea to the Caspian Sea, the investigated line Baku - border point to Georgia goes in a north-west direction from Baku to Tbilisi and is constructed as an electrified double track line. Its length is about 487 km. Annex 3.1.1-1 contains a survey of the track line Baku - border point to Georgia.

The double track is only interrupted by a single track section between km 73.9 and 72.9. Side track length is 503 km. The border station on the line Baku-Georgia is situated in Beyuk-Kyassik and the border point is located 3.0 km behind this station. The main line (further referred to as the investigated line) is equipped with 1,475 switches and the track is of a Russian design.

3.1.1.1.1 Composition of the permanent way

Rails

The most used track material is supplied by the Russian industry. On the main line the rail profile is R 65 (65 kg/m) and is supported by concrete monobloc sleepers which are also supplied by Russia. On the investigated line, the rails are posed in lengths of 800 m with an interruption section of three lengths of 25 m and 4 expansion gaps. The rail quality used in AGZD belongs to the self - hardening and heat treated rails, which are rails of the familiar UIC qualities and covers a strength range from about 800 to 1,200 N/mm^2. Self - hardening rails dominate the market and practically all current applications can be covered with these rails. A distinction can be made between 4 groups:

- rails with a 690 N/mm^2 minimum tensile strength corresponding to UIC requirements
- rails with a 820 N/mm^2 minimum tensile strength corresponding to ASTM and GOST requirements.
- rails with a 880 N/mm^2 minimum tensile strength corresponding to the wear resistant qualities and
- rails with a 1,080 N/mm^2 minimum tensile strength which are used to a great extent when high operating loads exist.

The rail R 65 used in the Caucasian Railways corresponds to group two and three.

Table 3.1.1-1 below provides a survey of the chemical composition of the above mentioned self-hardening rail steel types used in AGZD. Carbon manganese steels are involved in all cases. The carbon contents are in the range of 0.40%-0.82%, manganese 0.70%-2.10%, silicon 0.10%-0.50% and correspond with UIC-standards.

Table 3.1.1-1: Analysis of rail steel qualities used at AGZD

Mechanical properties and chemical composition of delivered rails								
Type of rail	Delivery condition	name of steel	Chemical composition, content in %					Tensile strength N/mm²
			C	Mn	Si	S	P	
R75,R65	Gost 8160-63	M76	0.69-0.82	0.75-1.05	0.13-0.28	0.045	0.035	840
R65, chromic-ferrous	ChMTU 2-64-68	M71	0.65-0.76	0.75-1.05	0.13-0.28	0.045	0.035	900
R65, volume-tempered	ChMTU 2-59-68	M72	0.68-0.78	0.75-1.05	0.13-0.28	0.045	0.035	1,160
R50	ChMTU 6944-63	M75	0.67-0.80	0.75-1.05	0.13-0.28	0.045	0.035	840
R50	ChMTU 2-16-67	N865	0.56-0.75	0.60-1.0	0.15-0.30	0.06	0.07	800
R50, volume-tempered	ChMTU 2-59-68	M72	0.67-0.77	0.75-1.05	0.13-0.28	0.045	0.035	1,160
R50, surface-tempered	STU 71 MS-66-62	N865	0.56-0.75	0.60-0.90	0.15-0.30	0.06	0.07	950
R43,R38	GOST 4224-54	M71	0.64-0.77	0.60-0.90	0.13-0.28	0.05	0.04	800
Legend: C = Carbon, Mn = Mangan, SI = Silicon, S= Sulphur, P = Phosphorous								

source: General Management of AGZD, Chief Engineer

Sleepers

The density of the posed sleepers in a straight line amounts to 1,840 sleepers, in curves it amounts from 1,840 to 2,000 and corresponds to an average sleeper spacing of 0.54 resp. 0.50 m. In addition to the concrete sleepers, timber sleepers were also laid. The timber quality is pine wood which has been treated by impregnation. The average lifetime ranges to 15 years. The better timber quality is beech or oak, but both qualities are not available or too expensive.

Fastening of the rail to the sleeper

Rail fixing to the concrete sleeper consists of base plate with rigid clip. The base plate is fastened on the concrete body by an anchor bolt turned a quarter in a chamber. This kind of rail fastening is not in line with current practises in Western

countries because it causes the loss of frictional connection by vibration of wheel/rail contact which damage the fixing chambers of the anchor bolt.

Rail fixing to the timber sleeper is carried out by spikes with base plate. This fastening system is not suitable, neither, because the rail/wheel contact vibrations loosen the fixing devices. In view of this inappropriate rail fastening to the timber sleeper, improvements have been started by coach screws, particularly in curves.

Switches

As mentioned above there are 1,475 switches on the investigated main line. All of them are connected with the main line. They are marked as R65 (construction mark rail 65) and 1:11 (1/11 angle of inclination as geometric mark), the branch track radius is not specified. On the investigated line, the turnouts are equipped with foundered monobloc of the same steel quality as the rails. The switches used in AGZD correspond with switches used in Europe.

Level crossings

30 level crossings are installed on the main line of which 8 are served automatically, 11 electrically by push button, and 11 by hand.

3.1.1.1.2 Bridges and tunnels

Tunnels are not constructed on the main line Baku - border point to Georgia and vice versa. On the other hand, there are altogether 985 bridges installed. These constructions are divided up into bridges of lengths up to:

25 m	-	680 constructions
100 m	-	57 constructions
> 100 m	-	5 constructions

Furthermore, there are 243 constructions like culverts, arched stone and concrete drain pipes up to a span of 2.00 m. The year of construction of all types is given by AGZD as between 1883 - 1904. The present situation of these bridges is said to be satisfactory and needs no repair. In Annex 3.1.1-2 the bridges of great importance are enumerated. This list only contains bridges with a length of more than 25 m and up to 100 m. All bridge constructions are arched stone bridges, reinforced concrete bridges and metallic decks assembled by rivets or bolts. The bridges are generally well maintained and in a satisfactory condition. Some bridges are in critical condition and need major repair or renewal. The arrangements for their rehabilitation are described later in the respective chapter.

3.1.1.1.3 Ballast

The main line is constructed on a 30 to 35 cm ballast bed. The gauge standard is 40/70 mm. At present AGZD exploits two quarries, one is located in Shamkir, the other in Kizildja. The broken stone from the Kizildja quarry is of a high quality but the daily production is insufficient. In Shamkir, only coarse gravel is extracted and even though it is used it is not qualified as ballast. The gravel is not broken down in fractions, rolling down and not compressible.
Laboratory test results have not been available but it is said that these tests are on-going.

Most parts of the ballast bed on the main line are in a very bad condition due to the missing periodical ballast-cleaning, the climatological erosion, sand drifts and traffic pollution (petrol and salt transports).

A high percentage of fine granulation fraction contained in the ballast (lack of washing equipment) and the before mentioned factors lead to rapid pollution, which causes the ballast to loose its dynamic absorption, elasticity, water permeability, aeration and electrical insulation properties. The ballast cannot distribute the wheel load from moving vehicles over the sub-ballast as evenly as necessary neither provide adequate resistance to both longitudinal displacement and lateral shift.

3.1.1.1.4 Subsoil

The subsoil will have the required support capability for accepting the static and dynamic forces arising from train traffic only if its elastic module is $E>800kp/cm^2$. This value could not be proved. In most parts of the track line a lot of muddy patch in the ballast had been identified. The subsoil has not the required support capability. Subsoil investigation by either digging below the surface or drilling tests with laboratory analysis are necessary so that an improvement of the subsoil can be planned and implemented when the track is renewed.

3.1.1.1.5 Technical layout data and specification of track geometry

The evaluation of the longitudinal profile only of the main line Baku - border point to Georgia and vice versa, resulted in the following data:

axle load 23 t
minimum radius 350m
maximum super elevation 150 mm, with parabolic transition curves
maximal vertical gradient 12‰
vertical or levelling curves 300 - 3,000 m
distance between centres of lines 4,100 mm
distance between centres of lines in stations 5.30 m
average sleeper spacing 1,840, in curves up to 2,000.
permissible speed 100 km/h for passenger trains
permissible speed 80 km/h for freight traffic
gauge 1,520 mm; minimum 1,516 mm, maximum 1,540 mm.

The longitudinal profile is drawn in a scale of 1:10,000 and the length in a scale of 1:1,000 and 1:500 respectively. Not only the level of the upper surface of the rail but also the level over ground is indicated. The maximum height above ground amounts up to 12 m. The areas on both sides of the track line are used for agriculture or forestry.

3.1.1.1.6 Arrears in maintenance and damaging/destruction of assets

The investigated track Baku - border point to Georgia is in a bad technical condition. A track inspection from Baku to Pirsagat stated that the actual situation would be hopeless for a serious traffic handling. The ballast bed is compacted like a concrete slab. Annex 3.1.1-3 shows the worst track sections with an overall amount of 200 km track in worst condition. The hammer effect of the wheel/rail contact is reflected instead of absorbed resulting in no more elasticity, water permeability and aeration

with the unavoidable consequences of the destruction of the track assets, damaging concrete sleepers and loss of rail fastenings. Furthermore, the load limit of 500 million tons/km is exceeded to a great extent.

As a result of this compact ballast bed, 165 broken rails have been recorded in 1995/1996, all of them on the line Baku - border point to Georgia. The distribution to the various districts is shown in the following table.

Table 3.1.1-2: Statistic of broken rails 1995/1996

district	broken rails
Baladshary	23
Baku	52
Kyrdamir	42
Gyandsha	12
Akstafa	6
Yevlakh	30
Total	165

source: track division

The arrears in track maintenance are due to the fact that AGZD depends totally on imports for all its track materials, except ballast, from the former Soviet Union. Due to financial difficulties, AGZD is presently unable to order the required track material. Since 1989, the annual track renewal programme of 150 - 200 km had been scaled down. The renewal programme in the last three years was as follows:

1994 - 40 km in 1994
1995 - 44 km in 1995
1996 - 10 km in 1996.

The regular track maintenance is based on the accounted load limit in tons per km. For track renewal a load of 500 mill. tons per km is fixed, however an overload of 600 mill. tons per km or even more is possible. The situation regarding the existing maintenance backlog on AGZD is shown in Table 3.1.1-3 below.

Table 3.1.1-3 represents the entire network and gives a survey of the technical condition of the track lines. The shaded lines mean districts located on the investigated line.

Table 3.1.1-3: Survey of track lines of AGZD network and urgent required track renewals

No.	Name of the district	length of section km	track passed the load limit of 500 mill. tons/ km km	track below safety requirements[1] km
1	2	3	4	5
1	Khatshmas	239	83	29
2	Baladshary	127	39	0
3	Baku	212	72	38
4	Apsheron	226	64	9
5	Kyrdamir	277	100	37
6	Gyandsha	223	25	0
7	Akstafa	238	5	0
8	Saatly	251	44	4
9	Mindshevan	163	33	0
10	Ordubad	103	23	0
11	Nakhichevan	140	86	0
12	Salyany	219	98	1
13	Yevlakh	255	32	18
14	Shirvan	117	23	4
15	Shaki	162	122	140
	Total	**2,952**	**849**	**280**
	investigated line		273	93
	Percentage of endangered track		28.8%	9.5%

source: General Management of AGZD

The evaluation of the above table signifies that about 30 % (850 km) of the entire network have to be renewed and 10 % (280 km) are below the required safety level. Regarding the investigated line, there is a total of 366 km to be renewed. 200 km are of first priority (including 93 km on the main line) and the remaining 166 km of second priority (compare Annex 3.1.1-3).

3.1.1.2 Analyse of track and constructional work maintenance organisation and facilities

3.1.1.2.1 Methods and organisation of maintenance

In Annex 3.1.1-4 an organisation scheme of the track's economic division (General management) which is managed by the Chief Engineer is shown. The Chief Engineer organises the administrative work for track maintenance and related services of civil engineering in AGZD`s administration building in Baku including the districts and other work-units located on the main line. The organisation structure only shows the work- units participating on the investigated line. Altogether, there were normally 3,726 employees which has now been reduced to 2,861 employees.

[1] Safety criterion: vertical rail wear more than 12 mm, lateral more than 6 mm as high deviation of 500 mln. tons load per km

The tasks of methodical maintenance is to be carried out by 15 districts for the whole network. Six of them are located on the line Baku - border point to Georgia. For the main line the following districts are responsible:

Table 3.1.1-4: Districts located on the investigated line

Name of the district	Responsibility for section in km	located at km
Baladshary	127	2,647
Baku	212	
Kyrdamir	277	342
Gyandsha	223	183
Akstafa	238	88
Yevlakh	255	250

The main tasks of a district are:

- visual control by walking on the side path and routine examination of the main system groups of the track, as rails, fastenings, sleepers and the ballast bed.
- irregularities in the track geometry as alignment, super-elevation, square position of the sleepers.
- recurrent switch examinations of all switches of the district,
- replacement of switch parts with switch tongues, built-up common crossings several types,
- replacement of switch sleeper sets,
- small track renewals up to 400 m, mainly at stations,
- special investigation by order of the chief engineer
- emergency repairs, for example of broken rails. In 1995/1996, 165 broken rails were recorded, 52 of them in the Baku district. Corresponding to the instructions, the broken rails have to be repaired by changing them to a standard rail length of 25 m. All broken rails have to be journalised with details about district, line or station, track number odd or uneven, km point, panel number, left or right rail and rail type. The rail damages have to be described and must be signed visually on the inside or outside of the damaged rail. An engineering manual gives instructions about all types of rail damages.
- manually ultrasonic testing carried out by a specialised team in each district performance 3-5 km/hour, the results are reported.

In addition to the above mentioned track and rail tests, the rails of the entire network are examined ultrasonically and magnetically by 3 inspection coaches owned and operated by the central management at Baku (defectoskop coaches 312, 411 and 365). A track measuring coach located at district Baku records the geometrical parameters of the entire track - network twice a month. The results from the geometrical measuring is assessed by a digital quality coefficient concerning all deficiencies of the geometrical parameters. The classification of the calculated coefficient is, as shown in Table 3.1.1-5.

Table 3.1.1-5: Classification of the quality coefficient

0	-	**40**	very good, practically after a general track renewal
40	-	**100**	good, several points in the line are to be checked
100	-	**500**	tendency from moderate to bad, consequent observation till part renewal, ballast cleaning, sleeper and rail fastenings changing
		> 500	bad, the track needs renewal, after a lifetime of 15-20 years

source: track division

Due to the lack of regular maintenance in the last 7 years, it often occurs that the coefficient appears to be of four digits. An evaluation of 500 and higher is normally attained when the load limits of 500 million tons /km have been achieved and methodical maintenance has been neglected. The district is obliged to rehabilitate the worst points of the track to provide safe traffic conditions or to install permanent speed restrictions which correspond to the actual situation of the track, if track materials are not available. The main activities of the gangs of a district are to repair the tracks so that traffic is possible even if the permissible speed is restricted. The possibilities of a district to do efficient track maintenance are very poor due to the lack of materials, small track engines and tools.
Facilities like the district office building, workshop, social rooms are very poor and need a consequent planned and executed modernisation. The mobility is broken down by missing all kinds of transport possibilities.
Annex 3.1.1-5 shows the organisation of the district Baku. The other ones are structured in the same way. Annex 3.1.1-6 indicates the basic equipment with small track - maintenance engines and tools to cope with the tasks.

3.1.1.2.2 Permanent way workshop

For major repairs and complete track renewals (general repairs) AGZD use three well equipped and staffed permanent way workshops. They are located at Kyourok, Sangatshali and Tsharkhi. A chief engineer manages the workshop and he gets his work instructions from the general management at Baku. The work instructions depend on the annual work - programme and the track material is stored in the workshops. The available track engines except for the UK units are of a Russian construction which are working with reduced efficiency because main inspections and general repairs could not be executed. The tamping, lining and ballast cleaner engine has to be replaced by a modern new one. The UK - system works with 25 m track panels, which are pre - assembled and loaded on special wagons. The panels are transported to the side and a crane known as the `Platow crane` takes the pre - assembled panels and puts them on the prepared track formation.
The special paired wagons can be loaded with 5 panels so that a unit of 12 wagons is needed for the transport of 750 m track. The same is needed for the transport of the removed panels. The work performed within 6 hours would include 1,200 m ballast cleaning, tamping, lining and ballasting. Actually, this performance is not possible with the available machinery. When site reports state a „line clear", the first 3 trains will go at 15 km/h, the next three at 25 km/h and then finally the permissible speed of 80/100 km/h is allowed.

The staff normally amounts to 144 which has now been reduced to 50. Annex 3.1.1-7 shows the organisation structure of the Permanent way workshop Sangatshali.

3.1.1.2.3 Welding plant at Salyany

The welding plant at Salyany is of great importance for track renewal for the whole network. It is said that at Salyany, the standard lengths of 25 m rail are welded to 800 m long rails. The transportation of them is carried out by special wagons without any real problems.

3.1.1.2.4 Depot and workshop for track engines repair at Baladshary

The Baladshary track engines repair plant was built in 1903. The buildings e.g. halls and shops are despite their age in a satisfactory condition. The tools and machine tools work but a modernisation will be necessary. At the moment, 100 workmen and 10 administrative employees are employed at this plant. The work orders come from the general management and these orders could be done if spare parts are available. The requirements resulting from the different inspections of track engines cannot be accomplished because of the lack of spare parts. The main tasks are focused on repairing diesel motors by dismantling others in order to get spare parts. A general modernisation on the existing buildings, new machine tools, tools and new work place organisation is necessary, the costs are estimated at **200,000 US$.**

3.1.1.2.5 General management division at Baku

The general division at Baku manages and controls all facilities which are positioned on the line and at the administration in Baku. All events that occur on the line and in the buildings are collected and journalised. The causes of defects and interruptions are discovered and measures are taken to prevent such events like derailments or other interruptions to train movements. The documents show frankly and openly the reality of the unsatisfactory situation of the damages on the track lines which originate from the lack of maintenance or necessary renewals. Due to the lack of financial means prevention of the track and building deterioration has been difficult over a lot of years. The most important document is the so called track passport or track C.V. in which all events on the track are shown since the last capital renewal. The main facts are: date of last renewal, traffic loads cumulated in million tonnes, wear of rails, number of damages on the rails, damaged sleepers per km, ballast pollution and interventions by maintenance measures or small repairs. Each km of the superstructure disclosed by this document can be examined at any time.
The general management division for the superstructure and all related services which are capable of finding out and journalising with exactness all important defects on track elements will be capable of renewing and maintaining their track line themselves because knowledge and skilled staff are available.

3.1.1.3 Analysis of weaknesses and limitations

3.1.1.3.1 General

In the sections above the existing situation of the main track line Baku - border point to Georgia and its related component parts has been explained. This section will make evident the damages and bottlenecks on the track line and point out what is to be done to eliminate all damages which are an obstacle to a steady flow of traffic.

3.1.1.3.2 Switches

There are 1,475 switches installed on the main line which are all connected with each other. All these connections have to be well maintained and to be in a good condition. It will be very important that all the inter-marshalling-yard trains pass the stations without any speed restrictions which are caused by badly maintained or damaged switches on the main line. However, these conditions can only be solved when the switches are renewed. The life-span of a switch is calculated at 30 years. With regard to the 1,475 switches installed, on the investigated line nearly 50 switches have to be renewed every year. The number of switches which have to be repaired yearly by replaced switch parts on the same track line is figured at 100 switches.

3.1.1.3.3 Bridges and tunnels

Most of the bridges on the main line (Annex 3.1.1-2) are generally in good condition because of methodical maintenance measures although there are some bridges which have to be rehabilitated by major repair or renewal. This section shows the bridges which urgently require heavy repair or renewal. According to information given by the AGZD Bridge construction department the cost data relating to bridge renewal are based on the actual project implementation.

Bridge construction in km 541 + 500

Bridge number 56 in km 541+500, entrance and exit of Baku main station is so damaged that the track panel over this bridge (right or even track) had been dismantled in July 1996. The bridge constructed as prestressed concrete slabs is in danger of collapsing because the prestressed concrete steel has been destroyed by street traffic. The concrete slab is no longer able to carry full dynamic load (moving train) on the bridge. The even track is locked for an indefinite period. All trains going to and coming from Baku are passing at the moment the temporary single - line working over the still well operating separate bridge of the odd track line. The detention of trains (passenger and freight) in junction stations has to be planned and careful traffic control has to be arranged. The project to renew this bridge part is in hand . A cost estimation has not been available. (In the meantime, this bridge had been pulled down.)

Bridge construction in km 157 + 700

The bridge construction number 19 and 20 of the bridge list in km 157+700 is jeopardised by the washing away of the foundations of the abutments and piers. River training and security measures have to be undertaken. Project documents are already prepared, but not shown for examination. The cost estimation is figured with 866,000 US$.

Bridge construction in km 111 + 200

The bridge construction number 10 and 11 of the bridge list in km 111+200 is partially in need of replacement. The work on the renovation are in hand. Project documents exist and the cost estimation is figured at 954,000 US$.

Bridge construction in km 234 + 600

The bridge number 31 of the bridge list in km 234+600 has to be completely renewed. The bridge openings of 4 x 3,60 m are to small for the mass of water

coming from the catchment area. The bridge is endangered of been washed away. Project documents do not exist. Cost estimation 100,000 US$.

Bridge construction in km 252 + 800

The bridge construction number 33 and 34 of the bridge list in km 252+800 needs a complete renovation. This bridge was constructed in 1927 as a riveted steel construction. The physical deterioration and heavy corrosion demand the total renewal of the bridge. Project documents are already prepared. The cost estimation is figured out at 2,950,000 US$.

Bridge construction in km 360 + 200

The bridge number 41 and 42 of the bridge list in km 360+200 demands a continuation of the safety and protection measures. The construction is in good condition but is endangered by the undermining by water of the foundations of abutments and piers. The project documents conclude an estimated cost of 200,000 US$.

Bridge construction in km 72 + 300

The bridge number 5 of the bridge list in km 72+300 was renewed in 1996 and is located in a single track-line section. This single track could be in the future a bottleneck when the line is carrying dense traffic. In the case of such improved traffic, a second track in this section would be needed. As a result, a second bridge will have to be constructed in order to have a free flowing traffic system. The project documents are prepared and the cost estimation is figured at 4,545,000 US$.

3.1.1.4 Track line rehabilitation

The permanent lack of finances ever since 1989 has led to the arrears in track renewals and in scheduled full track maintenance. The backlog in track renewals amounts to approx. 850 km (see Table 3.1.1-3). To catch up on this backlog, an extensive track renewal programme for the short term has to be started. Annex 3.1.1-3 contains the worst track sections on the main line with a length of about 200 km.

AGZD has no production of any track material except ballast. The possibility to supply the ballast for 200 km of track renewal by AGZD own quarries is at this time impossible for the reasons mentioned above.

The quarry equipment like the crusher, riddle system and wash equipment must be renewed so that the daily output could be raised to a sufficient quantity so that the indispensable ballast quantity could be supplied to implement the above mentioned track renewal. The current daily output from 300 m^3/day has to be raised as follows:

complete ballast bed renewal needs	2.0 m^3/m single track
200 km single track, = 200,000.x 2.0	400,000 m^3 ballast
additional 50 km on other tracks = 50,000.x 2.0	100,000 m^3 ballast
complete ballast after cleaning (80%) 2.0x100 km	160,000 m^3 ballast
other granulation productions, estimated	500,000 m^3 ballast
emergency stock and reserves	240,000 m^3 ballast
annual ballast production total	1,400,000 m^3 ballast

Thus, the daily output is to be raised to **5,600 m^3** ballast (1,400,000 divided by 250 working days) including other grain size fraction.

AGZD is able to do the track maintenance and track renewal themselves, man power and skilled staff are available. However, the best personal cannot work efficiently when the equipment and track engines are not working or are not available. This problem is also due to the financial situation over the last years.
Annex 3.1.1-6 shows the inventory and the shortage of small track maintenance machines and tools for one gang of the Baku district and extrapolated on 17 gangs (source of unit prices: Cemafer, Breisach). A cost estimation is made to replenish the shortage (see Table 3.1.1-6 below).

Table 3.1.1-6: Cost estimation to replenish the shortage of small track engines and tools for the Baku district

NR.	Designation	shortage	price per unit US$	total US$
1	Tamping units, type GB 4 with Briggs and Stratton engine (1 unit=4 hammers)	34	16,717	568,378
2	Rail saws, type SRN-E with electrical engine 220/380 V DC, 50 Hz	5	3,443	17,215
	Supplement for hydraulic device		983	983
3	Rail drilling machines, type PR 8-E-2V	2	3,933	7,886
4	Rail grinding machines, type MP 12-E	15	4,033	60,495
5	Coach screwing machines, type T52-E	31	6,097	189,007
6	Coach screwing machines, type TS2 with gasoline engine Bernard 617	34	6,490	220,660
	Supplement for torque limiter		295	295
7	Track lifting and slewing machines type RV 100 for track 1520 mm	2	39,333	78,666
8	Hydraulic jacks, type CH 65	35	930	32,550
9	Wooden sleeper carrying tongues	34	88	2,992
	Concrete sleeper carrying tongues	34	106	3,604
10	Hand operated rail pullers with chain	10	1,733	17,330
11	Generators, type CR 2500 with Briggs and Stratton gasoline engine	8	847	6,776
12	Generators, type RG 4500 T with Briggs &Stratton gasoline engine mounted on a hand pushed one wheel trolley, power 4 kW /220/380 V/50 Hz	2	1,733	3,466
13	Signalling lamps, 3 colour lights	129	243	31,347
14	Brigade carriers	12	40,000	480,000
15	Four wheel drive cars	2	30,000	60,000
	direct costs			**1,781,630**
	value added tax 15 % of 1,781,630			267,244.5
	dispatch and insurance 20% of 1,781,630			356,326
	Unforeseen			94,800
	Total			**2,500,000.**

The efficiency of a district depends on its equipment. Table 3.1.1-6 indicates the total costs of US$ 2.5 mill. to cover the shortage shown in Annex 3.1.1-6. This sum will be necessary for all 15 districts of AGZD; priority has to be given to the 6 districts located at the track line Baku-border point to Georgia. That means a total of US$ 15.0 million will be necessary for the main line. In due course, a current shortage list will have to be drawn up. With the added equipment and the possibility of mobilisation by their own brigade carriers, the scheduled full maintenance of the line will be ensured.

In addition to the above listed equipment and tools other very important engines for track maintenance will have to be purchased and have to be available at the districts. Table 3.1.1-7 shows these additionally needed engines for track maintenance. These engines are to be used as:

- bridge inspection vehicle to control periodically AGZD bridge constructions. The inspection coach will be administrated and organised by general management's bridge department.
- Track vehicle model VMT 850 will serve the districts located on the investigated line to ensure quick personal and material transports to the site,
- Rail/road loader excavator universal applicable for all kinds of excavation work.

Table 3.1.1-7: Additionally needed machinery for track maintenance

No	Designation	Unit	Price per unit in million US$	Total in million US$
1	2	3	4	5
1	Bridge inspection vehicle model 970 10A for track gauge 1520 mm	1	1.170	1.170
2	Track vehicle model VMT 850 BR with cabin and hydraulic crane, track gauge 1520 mm	6	0.570	3.420
3	Rail/road loader excavator KGT/V, track gauge 1520 mm and accessories	6	0.335	2.01
	Total			**6.600**

The track renewal is planned and executed by staff and equipment of the permanent way workshop. The available track engines and equipment are prone to break down due to their age. The break down stoppages when track renewals are in full progress, force the staff in charge and management to improvise. All improvisations influence the quality of the work and are the first reasons for increased maintenance measures. Annex 3.1.1-8 shows the inventory of track engines and their actual availability. These track engines have their origin in the former Soviet Union. They are very heavy, old and are no longer up to date for modern track renewals and maintenance measures. Instead of expensive repairs to the available engines e.g. VPO 3000 tamping and levelling, R 2000 track liner, it is recommended to purchase new ones. The ballast cleaner Shom has to be replaced by a new modern and more

productive working ballast cleaner which is able to clean the ballast to a depth of 1.00 m below the top of rail and where the guided excavation chain produces an exactly straight downgrade. The new track engines are to be considered as a unit consisting of: ballast cleaning, tamping and ballast regulating machine which will be needed twice, once in the short term and the other in the medium term. The Table 3.1.1-8 below shows the kind of track engines and unit prices for the required machines.

Table 3.1.1-8: New track maintenance and renewal engines

Item	short description	Price per unit in million US$
1	RM 80 UHR	
	Ballast cleaning machine for switches,	
	crossings and plain track universal application.	
	Length over buffers = 31.80 m	
	excavating width standard = 4.00 m	
	max. excavating depth below top rail = 1.00 m	4.38
2	Unimat 08-475 4S	
	perfect maintenance of switches and crossings.	
	Technical data	
	length over buffers = 33.99 m	
	width = 3.00 m	
	total weight of machine = 100 t	
	four tamping units	2.86
3	High performance ballast regulating machines	
	Technical data:	
	length over buffers = 17.45 m	
	width = 3.0 m	
	weight = 36 t	1.24
	Total	**8.48**

(source of prices: Plasser & Theurer, Austria)

The above listed machines are successfully working in CIS. In order to utilise high performance machine systems properly, it is essential to have a perfect user technology tailored to the specific operating conditions.

This user technology has been developed in close co-operation with the railway authorities on the basis of experience in many countries under the most varied climatic, geographic and permanent way conditions. Training programmes, tailored to the operating condition of AGZD are available.

The renewal system by UK (Platow Crane) contains rail changing when the panels are put down. The standard length of 25 m will be changed with long welded rails of 800 m. These rails could be changed by a hydraulic rail threater which accelerates

and facilitates the operating cycles. Therefore, to the above listed engines have to be added:

hydraulic rail threater type MPR, hydraulically controlled turntable and off tracking equipment -power 6 t- price/unit 0.550 million US$

Three of them have to be purchased and located at the Permanent-way-work-shops. The total would be 1.650 million US$.

Other important weaknesses are the quarries, vandalised and destroyed of their most important equipment they are unable to produce the different fractions of grain in sufficient quantity and quality, especially ballast and others determined for prefabricated concrete parts.
Full working quarries will be the precondition to produce high quality of ballast for the permanent way and all required grain size for the production of prefabricated concrete parts, even prestressed concrete sleepers. An estimation given by the AGZD authorities amounts to 0.60 million US$. It includes the following

- new crusher and riddle systems
- pipes and conveyor belts
- wash equipment to clean the broken stones from dust and filler
- bulldozers, excavators and trucks
- other materials for the renovation of offices and social rooms.

The dependence to import all track materials increases the expenditure for track maintenance and track renewal. With modern equipped quarries AGZD would be able to develop their own prestressed concrete sleeper production with a new kind of sleeper, according to the European standard sleeper design and fastenings. First investigations show that a full mechanised concrete sleeper plant will cost 12. million US$ and a partial mechanised one 8.7 million US$. These prices do not include ground, land development, work-halls, storage area, necessary infrastructure like roads, works siding, power sources and water. This preliminary calculation is based on an annual long-term track renewal of about 150 km / year and corresponds to a production of almost 300,000. concrete sleepers yearly.
An economic solution would be one concrete plant for all Caucasian countries. An uneconomic solution would be the establishment of a concrete sleeper plant in each country. The figure of 12 or 8.7 million US$ will not be entered into the financial pre-feasibility calculation. The Joint Venture Report will fix the areas to be supplied with sleepers and give details relating to siting using the existing concrete plants, raw materials such as sand, gravel, stone chips, cement and steel reinforcement.

3.1.1.5 Definition of training needs

Professional skill is the most important requirement in order to achieve quality and high performance in mechanised track works, track renewal and track maintenance. The skill is required in 3 fields

- **economical track renewal and maintenance system**
  Operation staff of the general management includes the permanent way inspector. The training consists of the organisation and handling of computer-aided track renewal and track maintenance systems used in western countries, work studies, work programmes, time schedules of site completion, fabrication and maintenance of continuously welded rails, updating of engineering manuals and instructions, competitive procurement procedure,

computerising of track inventory and constructions. Financial requirements and budget planning for the short and long terms track renewal and track maintenance. The aim of an intensive training of higher management is to minimise the costs of route maintenance and renewal as basic managerial decisions. They cover the adoption of long welded rails via retrofitting with stable new rail supports up to the adoption of a conveyor line method in track rebuilding.

- **operation of new track engines**

- **maintenance of machines**
  The new track engine generation needs intensive operation training and servicing staff and is thus gaining greater importance for the successful and economical operation of the machines. In order to utilise properly high performance machine systems, it is essential to have a perfect user technology tailored to the specific operating conditions. The training programme will help the machine crews to operate the engines at a high performance level. Objective of the training programme will be to inform and to teach the managers and the leaders of the machine crews how to operate the engines in order to get the best results in performance and a long service life. The training should be implemented by seminars of several 1 - 2 months periods depending on the basic knowledge. The programme contains theoretical and practical parts as well as visits to sites. Required are skilled personnel for machine operation, machine crew and members, for machine maintenance service specialists, mechanics and electricians.

Training programs are to be fixed with the managerial staff of AGZD and to be coordinated with the host countries. Approximately 40 people are expected to participate on training programs and the costs are estimated at up to 500,000. US$.

3.1.1.6 Financial pre-feasibility

The financial pre-feasibility renders a general view of the possible expenditure which is necessary to realise the rehabilitation of the investigated line described above. The cost estimations are divided in five parts (compare Annex 3.1.1-9)

.

Part 1 - Track and switch renewals
Part 2 - District equipment
Part 3 - Equipment and engines for permanent-way-work-shop
Part 4 - Bridge renewal and major repair
Part 5 - Quarry equipment
Part 6 Training

The main part would be the expenses to renew and to maintain the investigated line. Preconditions are equipment, tools and engines, therefore the placing of orders for these items have first priority. The recommended engines and equipment represent the basis to achieve the fully scheduled maintenance system by a new machine generation. The cost estimation for track renewal is based on calculations compiled by AGZD in June 1996 and is shown in Table 3.1.1-9 below. Districts and

permanent way workshops equipment are based on the price level of Western manufactures. Rehabilitation costs of bridges are given by AGZD and correspond with the available project documents.

Table 3.1.1-9: Calculation of one km track renewal

Item	Designation	unit	quantity	price/unit in US$	Total in US$
1	2	3	4	5	6
1	Labour costs	km		1,022	1,022
	Material costs				
2	rails R 65	t	129.3	870	112,491
3	fish plates	t	4.6	883	4,062
4	bearing plates	t	28.21	873	24,627
5	fish plate bolts	t	0.32	993	318
6	T-headed bolt	t	5.3	1,141	6,047
7	locking bolt	t	3.49	1,299	4,534
8	clamp	t	4.86	1,041	5,059
9	joint plates	t	0.044	4,445	196
10	double spring washer	t	1.77	1,594	2,821
11	flat plates	piece	7,361	0.22	1,619
12	iso bushes	piece	7,361	0.27	1,987
13	pads KB 10	piece	3,680	0.69	2,539
14	pads PB 65-1	piece	3,680	0.42	1,546
15	iso-fish-plates	set	2	11	22
16	set of iso-joints	set	2	2.5	5
17	concrete sleepers	piece	1,840	27	49,680
18	ballast	m	1,500	8.3	12,450
19	track engines				133
	direct costs				**231,158**
	Extra charges				
20	overhead costs	%	13	annulled	
21	severance pay	%	20	1,022.	204
22	allowances	%	30	1,022	307
23	loco-costs				3,333
24	unforeseen	%	0.5	235,002	1,175
	Total costs of one km track renewal				**236,177**

(source: track division)

The costs itemised in the afore Table for 1 km of track renewal seem to be rather low as compared with the European price level. A price calculation for 1 km of track

requested in August 1997 differs only insignificantly. To allow a comparison the direct costs are indicated without surcharges.

- direct costs of the calculation of June 1996 = US$ **231, 158**
- direct costs of the calculation of August 1997 = US$ **231, 220**

In this connection there should be mentioned that the wages have gone up from US$ 1.022 in June 1996 to 2.125 per km of track renewal in August 1997. Yet, the material prices differ only insignificantly. The excess costs of 13 % of the direct costs seem to be estimated too high as compared with the total calculation and are not justified. The material costs involve already the excess costs. Thus they are not considered in the total. According to the following comparison of prices the material mass items of DB AG/AGZD are absolutely comparable, the wages paid by DB AG, costs of ballast and machinery per km of track renewal are not comparable with the costs of AGZD. Here, it should be noted that in all comparable items and in other items of DB AG all surcharges are already contained.

Table 3.1.1- 10 Comparison of costs for one km of track renewal at DB AG and AGZD

No	Designation	DB AG	DB AG	AGZD
		DEM/km	US$/km	US$/km
1	2	4	5	6
1	wages for 1 km	120,000	80, 000	1,022
2	UIC 60/ R 65 rails incl. transport and welding	169,000	112,667	112,491
3	sleepers incl. fixing and transport	166,700	111,133	105,062
4	ballast incl. transport	156,000	104,000	12, 450
5	track construction machinery	180,000	120,000	133
6	**Total**	**791,700**	**527,800**	**231,158**

The unit prices of the above mentioned track materials do not correspond in all items with western price level. The calculated costs per km track renewal have been rounded up to US$ 240,000 in the financial pre-feasibility assessment.

The afore-mentioned cost estimate involves the following work to make the sum of US$ 240,000 more transparent:

- lining of long rails at the place of mounting,
- piling of concrete sleepers in track laying yards,
- distribution of sleepers on the place of mounting,
- mounting of auxiliary rails on the laid sleepers to get 25 m long portable track sections,
- loading of the track sections onto track section transport wagons, always 5 sections onto wagons coupled in pairs,
- completion of the track under reconstruction in 25 m long sections, execution of separating cuts
- picking up and loading of the old track in 25 m long sections onto transport wagons,
- transport of old sections to the track laying yard and disassembly of the sections,
- sorting and piling of the removed materials to reuse them for secondary tracks,

- picking up and reloading of old ballast or lateral covering according to the profile or cleaning of the ballast up to 1,00 m below the lower edge of the rail by means of a RM 80 ballast cleaning machine to be purchased,
- laying of the pre-assembled sections for the new track, fishplating of the rail joints for site operation,
- ballasting of the new track,
- levelling and backfilling of the new track by means of a high-performance ballast regulating machine,
- first and second compaction cycles by means of a high-performance Unimat 08-475 4S tamping machine,
- replacement of the auxiliary rails with the long rails distributed onto the construction site by means of a rail hydraulic threater of the MPR type,
- tamping and straightening cycle with the aid of the afore-mentioned Unimat 08-475-4S,
- joint welding of long rails and
- levelling, last backfilling and sweeping of the new track and execution of ballast shoulders according to the profile in front of the sleepers,
- acceptance and report on completion by the building inspection,
- costs of operational measures such as closure of the operational track, temporary single-track operation in the case of the track being doubled, aggravated train operation programs.

All these afore-mentioned measures are covered by the US$ 240,000 for 1 km of track renewal.

Table 3.1.1-11 below summarises the investment costs for the rehabilitation of the track line Baku-border point to Georgia and calculates a final total of **151.573 million US$.**

Table 3.1.1-11: Summary of financial means to rehabilitate the track line Baku - border point to Georgia

No	Designation	Amount in million US$ priority 1*	priority 2*	total
1	2	3	4	5
1	Track and switch renewals on the investigated line	57. 400	39. 840	97. 240
2	Equipment of districts	21. 600	-	21. 600
3	Permanent-way-work-shop	10. 744	10. 074	20. 818
4	Bridges renewals and major repairs	6. 070	4. 545	10. 615
5	Quarry equipment, engine repairing	0.800	-	0.800
6	Training needs	0.500		0.500
	Total	**97. 114**	**54. 459**	**151. 573**

We proceed from the following schedule in implementing the afore-mentioned measures item 1 - 6, based on the AGZD track and bridge renewal capabilities:

- Item 1: Track and switch renewal, starting phase 70 km + 50 switch units, following year 146 km + 75 switch units, following year 150 km + 75 switch units;

including a replacement of the switch sleepers. Subsequent to implementing track renewal measures on the line the track will be maintained and renewed according to plan which is fixed with 40 km of track and 50 switch renewals per year. The expenses on it shall be then covered by AGZD on the basis of its profit, thus not being included in the program of rehabilitation.

- Item 2: Equipment for districts, starting phase inventory taking and 33.3 % of the order, the remaining 66.6 % in the following year
- Item 3: Permanent way work shop, outfitting is imperative to carry out track laying and will have to be done in 2 phases.
- Item 4: Bridge renewals and major repairs, priority one in 3 phases, priority 2 if the operating conditions (high traffic volume) will justify it.
- Item 5: Quarry equipment and track engine repair plant, without delay, as big quantities of ballast of best quality are required and there is a high demand for track laying machines to carry out repair.
- Item 6: Training without delay, modern management in track maintenance and renewal is absolutely necessary and should be provided before starting comprehensive rehabilitation. The instruction should be followed by practical application in implementing the rehabilitation measures.

The following Table 3.1.1.-12 shows the investment required per year for the rehabilitation of the Baku-border point to GRZD line. The schedule is based on the rebuilding capacities available in the own enterprises if it will be possible to purchase the necessary equipment and machinery.

Table 3.1.1-12: Investment flow in annual rates for the rehabilitation of the Baku - border point to GRZD line.

No	Designation	1998	1999	2000	2001	2002
		1,000 US$	1,000 US	1,000 US	1,000 US	1,000 US
1	2	3	4	5	6	7
1	track renewal 70, 146, 150 km	16,800	35,040	36,000		
	switch renewal 50, 75, 75 pieces	2,000	3,000	3,000		
	crossing timber sets 50, 45, 45	500	450	450		
2	district equipment 33.33 % of 21,600 66.66 % of 21,600	7,200	14, 400			
3	permanent way work shop	10,744	10,074			
4	bridge renewals 6,070 :3	2,023	2,023	2,024		
	4,545 if necessary				4,545	
5	quarry equipment	600				
	track engine repairing plant	200				
7	training	500				
	As of 2001 a planned track maintenance will take place.					(9,600)
	switches					(2,000)
	Total 151, 573	**40,567**	**64,987**	**41,474**	**4,545**	

The complete overview is to be found under Annex 3.1.1-9

3.1.1.7 Conclusions concerning the rehabilitation of the permanent way between Baku - border point to Georgia

The investigated line demonstrates a high backlog of a fully scheduled track maintenance and a annual track renewal system. Over the last seven years AGZD services have been forced to undertake an ever increasing number of urgent repairs on separate small line sections. This method has created a sort of patchwork on the line that prevents a systematic approach to structural maintenance and renewal policy as it is usually required to assure safe traffic and homogeneous quality on all line sections. The main evident defects concern the following basic principles are as follows:

- poor condition on track subgrade, irregular profile and slope, insufficient ground base and draining capacity adapted to the existing subsoil quality
- low quality of ballast, due to the lack of side paths the sleeper ends are not supported by ballast and has led to defective rail fastenings and damages on wooden and concrete sleepers.
- tracks laid in cutting areas are not properly drained.
- the contact wheel/rail has to be regular and continuous to avoid or to reduce dynamic corrosions.

It is obvious that the most of the recorded defects concern these basic principles and represent the cause for the rather low degree of reliability. Furthermore, it is impossible to ensure traffic safety on the present basis even if many checks are carried out. It is necessary to abandon the Russian rules and maintenance procedures and to introduce modern maintenance systems and procedures.
The main improvements to the above mentioned defects are as follows:

- the foundation of the track has to be performed carefully, regarding the slope and side paths imposed by a cross-section type.
- new prestressed concrete sleepers including new rail fastening elements.
- washed broken stones as ballast with high resistance regarding the prescribed grain size.
- to introduce the technology of continuous long welded rails in track lines as well as in switches sections. Knowledge of aluminothermic rail welding has to be acquired.
- scheduled full maintenance in both track and constructions.

The different divisions and their calculated costs are listed in Annex 3.1.1-9 and show also the priorities of the measures. Table 3.1.1-12 shows an engineering time schedule in which the projects will be carried out.

Annexes

Annex 3.1.1-1	Survey of the track line Baku - border point Georgia
Annex 3.1.1-2	List of bridges located on the investigated line
Annex 3.1.1-3	Worst track sections on the investigated line
Annex 3.1.1-4	Organisation structure of permanent-way general management
Annex 3.1.1-5	Organisation of the Baku - district
Annex 3.1.1-6	Inventory of small track maintenance engines and track tools
Annex 3.1.1-7	Organisation structure of permanent-way work shop Sangatshali
Annex 3.1.1-8	Inventory of track engines
Annex 3.1.1-9	Cost estimation of track renewal and associated equipment

Final Report Module A

Chapter 3 Technical Pre-feasibility

3.1 Track and Constructional works
3.1.2 Georgia

3.1.2 Track and constructional works on Georgian Railways

3.1.2.1 Existing situation

The entire network is electrified with 3.3 kV DC. Georgian Railways (GRZD) have 1,569 km of railway lines from which 766 km are main lines and 290 km are double track. Table 3.1.2-1 shows the operational track lengths of the main lines.

Table 3.1.2-1: Operational track lengths of GRZD network

No	Section	track length (km)	No. of tracks
1	2	3	4
1	Russian border - Otshamtshir	155	single
2	Otshamtshir - Ingiri	40	single
3	Ingiri- Senaki	39	single
4	Senaki - Samtredia	14	single
5	as above	14	double
6	Samtredia - Brozeula	26	double
7	Brozeula - Rioni	4	single
8	Rioni - Zestafoni	31	double
9	Zestafoni - Khashuri	43	double
10	as above	18	single
11	Khashuri - Gori	44	double
12	Gori - Tbilisi Usl.	81	double
13	Tbilisi - Border AGZD	42	double
14	Tbilisi - Border ARM	9	double
15	as above	57	single
16	Tbilisi Sort - Post 2512	2	single
17	Senaki - Poti	41	single
18	Batumi - Samtredia	106	single
	Total main lines	**766**	
	double track	290	
	single track	476	
	Total branch lines	806	
	Narrow gauge line	38	
	Total network	**1,569**	

source: track division, GRZD

Track line border point to AGZD - Tbilisi - Senaki - Poti

The track line border point to AGZD - Tbilisi - Senaki - Poti, referred to as the investigated line, leads in a western direction via Tbilisi - Senaki to Poti. The line is constructed as a double track line over 281 km and there are some sections constructed as a single track line. These interruptions are as follows:

Khashuri - Zestafoni	18 km
Rioni - Brozeula	4 km
Samtredia - Senaki	14 km
Senaki - Poti	41 km
Total of	77 km

The total length of the investigated line is 358 km. The border station on the track line to AGZD is Gardabani. Except for the narrow - gauge line Borshomi - Bakuriani (38 km), all lines are in Russian broad gauge of 1, 520 mm. From Tbilisi main lines branch off to:

the Armenian border town Ayrum via Gyumri to Yerevan and
the Azerbaijan State Railways

The main line is equipped with 1,397 switches. The track is based on Russian railway design. Annex 3.1.2-1 shows a survey of the main line border point to AGZD via Tbilisi to Poti and of the permanent way services and facilities located on the line.

3.1.2.1.1 Composition of the permanent way

Rails

The track material mostly used is supplied by the Russian industry. On the investigated line the mostly used rail profile is R 65, some sections as Senaki - Poti, Tbilisi - Sadakhlo and Batumi - Samtredia are equipped with light rails R 50. The rails are supported by concrete monobloc sleepers also supplied by Russia. On the investigated line, the rails are posed in length of 800 m with an interruption section of three standard lengths from 25 m resp 12.50 m and 4 expansion gaps. The rail quality used in GRZD belongs to the self - hardening and heat treated rails, which are rails of the familiar UIC qualities and cover a strength range from 800 to 1,200 N/mm^2. Self - hardening rails dominate the market and practically all current applications can be covered with these rails. A chemical analysis of the steel quality was not available but they are the same rails as those used in AGZD. Carbon manganese steels are involved in all cases. To correspond with UIC - standards the contents range as follows:

carbon	0.40 % - 0.82 %
manganese	0.70 % - 2.10 %
silicon	0.10 % - 0.50 %

The rails used in GRZD comply with the above mentioned conditions.

Sleepers

The density of the posed sleepers in a straight line comes to 1,840 sleepers per km. In curves the density increases from 1,840 to 2,000 per km and corresponds to an average sleeper spacing of 0.54 resp. 0.50 m. In addition to concrete sleepers, timber sleepers were also laid. The timber quality is pine wood treated by impregnation. The average lifetime ranges to 15 years. Better timber quality is beech or oak, but these are not available or are too expensive.

Fastening of the rail to the sleeper

The rail fastening systems are the same as used on the AGZD network..

Switches
As mentioned above there are 1,397 switches on the investigated main line. All of them are connected with the main line. They are marked as R65 (construction mark) and 1:11 (1/11 angle of inclination as geometric mark), the branch track radius is not specified. On the investigated line, the turnouts are equipped with foundered monobloc of the same steel quality as the rails. The switches used in GRZD correspond with switches used in Europe.

Level crossings
There are 30 level crossings on the investigated line. (For more details see section 3.3)

3.1.2.1.2 Bridges and tunnels
GRZD's track network is equipped with all kinds of artificial constructions as well as tunnels. There are 5 tunnels located on the main line whose lengths differ from 50 to 4,000 m. The tunnels need an increased maintenance and special investigations to check the water outlets and damaged brickwork lining in some parts of the tunnels. The most important bridges are listed in Annex 3.1.2-2 including information about the location, kind of crossing, length in m, damages and the line on which the bridges are erected. Annex 3.1.2-2 presents 80 bridges with a total length of 7,530 m. Constructions as culverts, arched stone and concrete drain pipes up to 2.00 m span are not quoted. The year of construction of all types is given by GRZD as between 1896 - 1907. Most of the bridges are in satisfactory condition, but some need, in addition to a full scheduled maintenance, some bridge renewals. All bridge construction methods are arched stone bridges, reinforced concrete bridges and metallic decks assembled by rivets or bolts. The arrangements for their rehabilitation are described in the respective section below.

3.1.2.1.3 Ballast
The main line is constructed on a 30 to 35 cm ballast bed. The gauge standard is 40/70 mm. At the moment GRZD exploits two quarries, one is located in Durnuki and the other is located near Tbilisi. The broken stone from the Durnuki plant (Zshradsma) is of a high quality (basalt) but the daily production is insufficient, and the second quarry only extracts river gravel which can not be qualified as ballast, but it is used, nevertheless.
The gravel is not broken down into fractions, rolling down and is not compressible. Laboratory test results have not been available but it is said that the tests are on going.
The most part of the ballast bed on the main line is in a very bad condition due to the missing periodical ballast-cleaning in addition to climatological erosion, sand drifts and traffic pollution. The high percentage of fine granulation fractions contained in the ballast (lacking of washing equipment) and the before mentioned factors lead to a rapid pollution which causes the ballast to loose its dynamic absorption, elasticity, water permeability, aeration and electrical insulation properties. The embankment slope is very irregular. Due to the lack of side - paths, sleeper ends are not supported by ballast and hang free, tracks laid in cuts are not properly drained. The ballast can not distribute the wheel load from moving vehicles over the sub-ballast as evenly as necessary, neither provide adequate resistance to both longitudinal displacement and lateral shift.

3.1.2.1.4 Subsoil

The subsoil will have the required support capability to withstand the static and dynamic forces arising from train traffic only if its elastic module is E>800kp/cm^2. This value could not be proved and in most parts of the track line a lot of muddy patch in the ballast was recorded. The subsoil does not have the required support capability in these sections. Subsoil investigations by digging below the surface or drilling tests with laboratory analysis are necessary so that an improvement of the subsoil can be planned and carried out when the track is renewed.

3.1.2.1.5 Technical layout data and specification of track geometry

The evaluation of the longitudinal profile of the main line border point AGZD to Tbilisi - Poti and vice versa, resulted in the following data:

maximum axle load 23 t
minimum radius 150 m
maximum super elevation 150 mm, with parabolic transition curves
maximal vertical gradient 29‰
vertical or levelling curves 300 - 3,000 m
distance between centres of lines 4,100 mm
distance between centres of lines in stations 5.30 m
average sleeper spacing 0.54 m with 1,840 sleepers/km, 0.50 m in curves up to 2,000 sleepers/km.
permissible speed 100 km/h for passenger trains
permissible speed 80 km/h for freight traffic
gauge 1,520 mm; minimum 1,516 mm, maximum 1,540 mm

The area on both sides of the track line is used for agriculture or forestry.

3.1.2.1.6 Arrears in maintenance and damaging/destruction of assets

The investigated track from the border point to AGZD - Tbilisi - Poti is in a poor technical condition. A current track inspection from Khashuri to Zestafoni and Tbilisi up to the border point to AGZD stated, that the current situation would be more than hopeless for the handling of serious traffic. The condition of the track is similar to the situation described under section 3.1.1.1.6. The arrears in track maintenance are due to the fact that GRZD depends totally on imports of all track materials, except ballast, from the former Soviet Union. Due to financial difficulties, GRZD is presently unable to order the required track material. Since 1989, the annual track renewal programme of 100 - 150 km had been decreased. The renewal work in 1996 was planned at 25 km provided that the financial means for the required material were available.

The existing situation is shown in Table 3.1.2-2 below. Table 3.1.2-2 represents the entire network and gives a survey of the technical condition of the main track lines.

Remarks:
In accordance with the instructions, track renewal is to be done
- after reaching the load limit of 500 million tons/km, an overload of 600 million tons/km and even more has been recorded
- if vertical rail wear is more than 12 mm, lateral more than 6 mm.

Table 3.1.2-2: Survey of main track lines of GRZD network

Survey of main track lines of GRZD network and urgent required track renewals					
No.	Name of district	responsibility for section km	track passed the load limit of 500 mill. tons/ km	track below safety requirements km	remarks
1	2	3	4	5	6
1	Sukhumi	122	0	0	
2	Otshamtshir	168	0	0	
3	Samtredia investigated line	203 138	58 47	68 65	
4	Batumi	120	50	51	
5	Zestafoni investigated line	165 64	51 46	64 21	
6	Khashuri investigated line	147 140	41 41	43 43	
7	Borshomi	82	28	37	
8	Tbilisi 1 investigated line	253 212	118 116	122 107	
9	Tbilisi 2 investigated line	234 94	89 53	84 25	
10	Gurdshari	187	0	145	
11	Zalka	160	0	150	
	Main track lengths	**1,841**	**435**	**764**	

(source: track division of GRZD)

An evaluation of the above table signifies that a total of about 65% (1,199 km main lines) of the entire network has to be renewed, of which 41% (764 km) are below the safety requirements. Regarding the investigated line, 564 km are to be renewed, of which 261 km are below the safety requirements and therefore have first priority for renewal.

3.1.2.2 Analyse of track and constructional work maintenance organisation and facilities

3.1.2.2.1 Method and organisation of maintenance

In Annex 3.1.2-3 an organisation scheme of the Track economics division (General management) is shown. The Chief Engineer and the Deputy for track maintenance organise the administrative work for track maintenance along with the associated and related services of civil engineering in GRZD's administration building in Tbilisi including the districts and other work units that are located on the main line. The organisation structure shows the work units participating on the investigated line.
The tasks of methodical maintenance are to be carried out by 11 districts for the whole network. Five of them are located on the line border point to AGZD - Tbilisi - Poti. The districts responsible for the investigated line are as follows:

Table 3.1.2-3: Districts located on the main line

Name of the district	Responsibility for section km	located at km
Samtredia	203	2,260
Zestafoni	165	2,321
Khashuri	147	2,382
Tbilisi 1	253	2,507
Tbilisi 2	234	2,507

(source: track division GRZD)

The main tasks of a district are:
- visual control by walking on the side path and routine examination of the main system groups of the track, rails, fastenings, sleepers and the ballast bed.
- irregularities in the track geometry in alignment, super-elevation, square position of the sleepers.
- recurrent examinations of all switches of the district,
- replacement of switch parts as switch tongues, built-up common crossings of different types,
- replacement of switch sleeper sets,
- small track renewals up to 400 m, mainly at stations
- special investigations by order of the chief engineer
- emergency repairs, broken rails, damage by derailments, buckling of track and ad hoc measures.
- manual ultrasonic testing carried out by a specialised team in each district performance 3-5 km/hour, the results are reported

Additional to the above mentioned track and rail tests, the rails of the entire network are examined ultrasonically and magnetically by inspection coaches owned and operated by the central management at Tbilisi (defectoskop department). A track measuring coach located at district Tbilisi records the geometrical parameters of the entire track network in regular intervals.
The results from the geometrical measuring is assessed by a digital quality coefficient concerning all deficiencies of the geometrical parameters. The classification of the calculated coefficient is as shown in Table 3.1.2-4.

Table 3.1.2-4: Classification of the quality coefficient

0	-	**50**	very good, practically after a general track renewal
51	-	**100**	good, several points in the line are to check
101	-	**500**	moderate to bad, consequent observation until partly renewal, ballast cleaning, sleeper changing and rail fastenings
		> 500	bad, the track needs renewal, after a lifetime of 15-20 years

(source: Engineering manual of GRZD track division)

Due to the lack of regular maintenance over the last 7 years, it often occurs that the coefficient appears as four digits. The evaluations of the coefficient at 500 and higher is normally attained when the load limits of 500 million tons per km have been reached and a methodically maintenance during the last 15 - 20 years has been neglected.

The district is obliged to rehabilitate the worst points of the track in order to guarantee safe traffic conditions, or to install permanent speed restrictions which correspond to the actual situation of the track, if track materials for repairing are not available. The main activities of the gangs of a district are to repair the tracks so that traffic is possible even if the permissible speed is restricted. The possibilities of the districts to carry out efficient track maintenance are very poor due to the lack of materials, small track engines and tools.

The facilities in the district office building, workshop, social rooms are very poor and need a consequent planned and executed modernisation. The mobility is broken down due to the lack of all kinds of transport possibilities. The district Tbilisi 1 employs 560 people. The average number of staff of a district is 450 - 500 people and depends on the length of the track section they are responsible for. Annex 3.1.2-4 shows the organisation of the district Tbilisi 1. The other ones are structured in the same way. Annex 3.1.2-5 indicates the basic equipment like small track maintenance engines and tools, which will be necessary to cope with the tasks.

3.1.2.2.2 Permanent way workshop

For major repairs and complete track renewals (general repairs) GRZD use two, former well equipped and staffed permanent-way workshops. They are located at Tbilisi and Samtredia. A chief engineer leads the workshop and he gets his work instructions from the general management at Tbilisi. The work instructions depend on the annual work programme and in this dimension the track material is stored in the permanent-way workshops. The available track engines are of a Russian construction. The tamping-, lining-, and ballast cleaner engines have to be replaced by modern ones. The UK - units that are working with a reduced efficiency need a general overhaul. Their working cycles have been described under section 3.1.1.2.2.

The staff normally amounts to 150. Annex 3.1.2-6 shows the organisation structure of the Permanent way workshop Tbilisi.

3.1.2.2.3 Welding plant at Tbilisi

The welding plant at Tbilisi is very important for track renewal on the whole network. The welding plant produces standard rail bars of 25 m to 250 m long rails. The transport of them is managed by special wagons without any real problems.
Only new rails are welded there. The re-use of removed rails is not practised.
The re-utilisation of removed rails is decided at site according to the following criteria:

vertical wear of the rail head 6 - 8 mm - may be used in main lines
vertical wear of the rail head more than 8 mm - in second lines only.

A second production line could be set up for which assumptions are favourable. A second flash - butt - welder is available and working but not installed. The welding

plant is equipped with two welding trains that are used for welding the prepared long rails of 250 m to 750 m by butt welding system on site. The welding plant is constructed on an area of about 6 ha and has enough space and buildings to allow an increase in their effectiveness. The buildings, workshops and other civil engineering works have to be repaired. At the moment there are 145 people employed, 25 for stationary welding, 20 on workshop production for related services and 100 on the welding trains.

3.1.2.2.4 Depot and workshop for track engine repair

A depot and workshop for track engine repair at GRZD is not available. In former times, the track engines had been repaired in a central depot of the former Soviet Union. This possibility no longer exists. Considering the common needs and public interest for the Caucasian Railways, a joint solution for GRZD and AGZD could result in participating in the re-development costs of the track engine repair depot at Baladshary.

3.1.2.2.5 Impregnation plant at Gori

At the moment and also in the former times the impregnation plant in Gori supplies the entire region (ARM, AGZD and GRZD) with impregnated timber sleepers. Thus, the impregnation plant is of a supra - national importance. The former simple one tank equipment had been extended in 1989 by two additional tanks including the building. The break up of the Soviet Union interrupted the planned extension so that the construction and the environmental conditions have to be carried on from their current state. The daily production amounts to 2,000 sleepers. This quantity is sufficient for all Caucasian countries and corresponds with 270 km track renewal per year with timber sleepers. The actually calculated quantity for all countries is at 150 km per year track renewal. All the creosote and 70% of the required wooden sleepers are imported from Russia, the other 30% of wooden sleepers are locally produced.

The impregnation method uses the vacuum system also used in European countries; one sleeper takes 8 - 9 kg creosote. At present, the production capacity is not fully utilised. The normal number of staff is calculated at 130 people; at the moment 30 are employed. The stock is figured out at 30,000 sleepers.

3.1.2.2.6 General management division at Tbilisi

The general division at Tbilisi manages and controls all facilities situated on the line and with the administration in Tbilisi (see Annex 3.1.2-3). The technical services are functionally co-ordinated All events that occur on the line and on buildings are collected and journalised. The causes of defects and interruptions are discovered and measures are taken to prevent such events like derailments or other interruptions to train movements.

3.1.2.3 Analysis of weaknesses and limitations

3.1.2.3.1 General

In the previous sections the existing situation of the main track line border point to AGZD - Tbilisi - Poti and its related component parts have been explained. This section presents the damages and bottlenecks of the track line and points out what should be done to eliminate the far reaching failures which are an obstacle to a steady flow of traffic.

3.1.2.3.2 Switches

There are 1,397 switches installed on the investigated line which are connected to the main passing tracks. All these connections have to be well maintained and have to be in a good condition. It will be very important that the marshalling yard trains pass the stations without any speed restrictions. This condition is only possible when the switches have been renewed and maintained as the current situation demands. The life - span of a switch is calculated at 30 years. With regard to 1,397 switches installed on the investigated line, nearly 45 have to be renewed every year. The number of switches that have to be repaired by replacement of switch parts on the same track line is figured out at 90 switches per year. Taking these figures as a basis, GRZD needs 400 switches R 65 1:11 and 150 crossing timber sets to rehabilitate the switches on the investigated line. That means a backlog of more than 8 years in switch renewals.

3.1.2.3.3 Bridges and tunnels

Most of the bridges on the main line (Annex 3.1.2-2) are generally in good condition due to methodical maintenance measures. However, there are some bridges that have to be rehabilitated by major repair or renewal. The following section shows the bridges which are in urgent need of heavy repair or renewal. According to information given by the GRZD Bridge construction department, the cost data relating to bridge renewal are based on the actual project implementation. The cost estimates mentioned hereinafter contain the following cost elements:

- building site equipment, machinery, appliances, excavators, caterpillars, power plants, workers' accommodation, site office,
- earth work, excavation and backfilling,
- masonry and concrete work, foundations, abutment, columns,
- road construction,
- assembly and dismantling of temporary bridges,
- connection and adaptation of tracks to the state of construction,
- supporting structure, steel and prefabricated supporting concrete structures,
- operational plants for train operation during construction,
- building supervision etc.

Proceeding from the work involved, the wide spans, and the sometimes inaccessible locations the cost estimates appear to be appropriate.

Bridge construction in km 2289+216
Bridge number 18 in km 2289+216, main line at Rioni. This bridge was constructed in 1896 and needs total renewal. Project documents were not available. Cost estimation 5.00 million US$.

Bridge construction in km 2324+239
The bridge construction number 27 on the bridge list in km 2324+239, main line is jeopardised by material fatigue. The bridge was constructed in 1907. Project documents were not available.
The cost estimation is figured out at 2.00 million US$.

Bridge construction in km 2404+790
The bridge construction number 56 of the bridge list in km 2404+790 crossing the Mtkwari on the Khashuri - Tbilisi line needs renewal. Bridge was built in 1896. Project documents were not available.
Cost estimation 2.0 million US$.

Bridge construction in km 2472+759
The bridge number 65 of the bridge list in km 2472+759 crossing the Mtkwari the Khashuri - Tbilisi line needs renewal. Constructed in 1896. Project documents were not available. The cost estimation is reckoned at 2.0 million US$.

Bridge construction in km 10+144
The bridge construction number 79 of the bridge list in km 10+144 crossing the Lotshino needs a complete renovation. This bridge was constructed in 1896 and the physical deterioration demands the bridge's renewal. Project documents are already prepared. The cost estimation is expected at 1.0 million US$.

Bridge construction in km 31+849 and others
The bridge number 1-4 and 10, 11 and 13 of the bridge list in km 31+849, crossing the Rioni, km 29+700 crossing the Korathi, km 21+791 crossing the Korathi, km 18+657 crossing the Korathi, km 2241+529 crossing the Abasha, km 2248+179 crossing the Nokhela and km 2255+143 crossing the Zkhenisskaro need renewal of the bridge sleepers. Altogether, there are 1,105 bridge sleepers to be renewed. The unit price of one bridge sleeper is estimated at 35 US$. The bridge in km 2248+179 and needs also far reaching corrosion protection.
Cost estimation for renewal of bridge sleepers amounts to 40,000 US$.
Cost estimation for corrosion protection 100,000 US$.

3.1.2.4 Track line rehabilitation

The permanent lack of financial means since 1989 has led to arrears on track renewals and in scheduled full track maintenance. Table 3.1.2-2 presents a survey on those sections for which the districts are responsible and makes a distinction between the track length and those located on the investigated line. The results are alarming, because 564 km of the investigated line has to be renewed within the next 3 - 5 years, from which 261 km have to be renewed as soon as possible.

In addition to Table 3.1.2-2, Annex 3.1.2-7 shows the permanent speed restrictions that are unavoidable as a result of the bad conditions of the track lines. Annex

3.1.2-7 illustrates the excess in view of loading and recorded quality coefficient. The realisation of the extensive track renewal depends on several conditions:

- production of own track material, mainly concrete sleepers and a new kind of rail fastenings,
- supply of sufficient ballast in quality and quantity by own quarries. That signifies the rehabilitation of equipment and machinery in order to increase the daily production of ballast including the production of various grain size fractions. The daily output must be the same as calculated for AGZD, i.e. 5,600 m^3/day.

GRZD is able to carry out the track renewal with own resources, man power and skilled personnel. However, the best personnel cannot be efficient, if the equipment and track engines are not working or are not available. Annex 3.1.2-5 shows the inventory and the shortage of small track maintenance engines and track tools. Table 3.1.2-5 shows the estimation of costs needed to replenish the shortage for all 11 districts and brigades.

Table 3.1.2-5: Cost - estimation to replenish the shortage of equipment

No.	Designation	shortage	price per unit US$	total US$
1	2	3	4	5
1	Tamping units, type GB 4 with Briggs and Stratton engine	75	16,717	1,253,775
2	Rail saws, type SRN-E with (SRN-E) electrical engine 220/380 V DC, 50 Hz Supplement for hydraulically device	50	3,443	172,150 9,830
3	Rail drilling machines, type PR 8-E-2V	50	3,933	196,650
4	Rail grinding machines, type MP 12-E	70	4,033	282,310
5	Coach screwing machines, type T52-E	60	6,097	365,820
6	Coach screwing machines, type TS2 with gasoline engine Bernard 617 supplement for torque limiter	50	6,490 434	324,500 434
7	Track lifting and slewing machines type RV 100 for track 1520 mm	11	39,333	432,663
8	Hydraulic jacks, type CH 65	600	930	558,000
9	Wooden sleeper carrying tongues Concrete sleeper carrying tongues	400 400	88 106	35,200 42,400
10	Hand operated rail pullers with chain	100	1,733	173,300
11	Generators, type CR 2500 with Briggs and Stratton gasoline engine	145	847	122,815
12	Generators, type RG 4500 T with Briggs &Stratton gasoline engine mounted on a hand pushed one wheel trolley, power 4 kW /220/380 V/50 Hz	150	1,733	259,950
13	Signalling lamps, 3 colour lights	860	243	208,980
14	Brigade carriers	45	40,000	1,800,000
15	Four wheel drive cars	22	30,000	660,000
16	Hammer sleeper spikes	300	32	9,600
17	Slewing bars different kinds	500	30	15,000
18	adjustable wrenches	300	45	13,500
19	wrench sets for track works	560	40	22,400
20	abrasive discs	8000	12	96,000
21	rail thermometer	50	60	3,000
22	rail pulling rollers	100	180	18,000
23	tamping pick	1200	35	42,000
24	wooden sleeper drilling machine	60	4,750	285,000
25	ballast forks	1200	35	42,000
26	sleeper changing machines	11	35,800	393,800
	direct costs			7, 839,077
	taxes, dispatch, insurance, unforeseen			2, 160,923
	Total in US$			**10,000,000**

(source of the unit prices: Cemafer, Breisach)

The efficiency of a district depends on its equipment. Table 3.1.2-5 indicates the total costs of US$ 10,000,000 to cover the shortage for all 11 districts shown in Annex 3.1.2-5. The 5 districts located at the track line border point to AGZD - Poti have first priority. For these districts a total of about 5,0 million US$ will be necessary. In due course, an actual shortage list has to be drawn up. With the added equipment and the possibility of mobilisation by their own brigade carriers the scheduled full maintenance on the line will be ensured.

In addition to the above listed equipment and tools, other very important engines for track maintenance are to be purchased and have to be available to all the districts. Table 3.1.2-6 shows the additionally needed engines for track maintenance. These engines are to be used as:

- Bridge inspection vehicle to control periodically GRZD bridge constructions. The inspection coach will be administrated and organised by general management's bridge department.
- Track vehicle model VMT 850 serves the districts located on the investigated line to ensure quick transport for personnel and for materials to the site and serves also rail/ road loader excavator universally applicable for all kinds of excavation work.

Table 3.1.2-6: Additionally needed machinery for track maintenance

No	Designation	Unit	Price per unit in million US$	Total in million US$
1	2	3	4	5
1	Bridge inspection vehicle model 970 10A for track gauge 1520 mm	1	1.170	1.170
2	Track vehicle model VMT 850 BR with cabin and hydraulic Crane, track gauge 1520 mm	5	0.570	2.850
3	Rail/road loader excavator KGT/V, track gauge 1520 mm and accessories	5	0.335	1.675
	Total			**5.695**

The track renewal is planned and executed by staff and equipment of the permanent way workshop. The existing track-engines and equipment are prone to break downs because of their age. The stoppages from the break downs when track renewals are in full progress force the responsible engineers to improvise. All improvisations influence the quality of the work and are the first reasons for the necessary increased maintenance measures. Annex 3.1.2-8 shows the inventory of track engines of GRZD permanent way workshop and their actual availability. These track engines have their origin in the former Soviet Union. They are very heavy, old and are no longer up to date for modern track renewals and maintenance measures. Instead of expensive repairs on the existing engines as VPO 3000 tamping and levelling, R 2000 track liner, it is recommended to purchase new ones. The ballast cleaner Shom has to be replaced by a new modern and more productive working ballast cleaner which is able to clean the ballast to a depth of 1.00 m below the top

of the rail and where the guided excavation chain produces an exactly straight downgrade. The new track engines are considered as a unit of ballast cleaning, tamping and ballast regulating machine. This unit will be needed twice, one in the short term and the other in the medium term. Table 3.1.2-7 below shows the kind of track engines and unit prices for required machines.

Table 3.1.2-7: New track maintenance and renewal engines

Item	short description	Price per unit in million US$
1	RM 80 UHR	
	Ballast cleaning machine for switches,	
	crossings and plain track universal application.	
	Length over buffers = 31.80 m	
	excavating width standard = 4.00 m	
	max. excavating depth below top rail = 1.00 m	4.38
2	Unimat 08-475 4S	
	Perfect maintenance of switches and crossings.	
	Technical data	
	length over buffers = 33.99 m	
	width = 3.00 m	
	total weight of machine = 100 t	
	four tamping units	2.86
3	High performance ballast regulating machines	
	Technical data:	
	length over buffers = 17.45 m	
	width = 3.0 m	
	Weight = 36 t	1.24
	Total	**8.48**

(source: Plasser & Theurer)

The above listed machines are successfully working in the CIS. In order to utilise high performance machine systems properly, it is essential to have a perfect user technology tailored to the specific operating conditions. This user technology has been developed in close co-operation with the railway authorities on the basis of experience in many countries under the most varied climatic, geographic and permanent way conditions. Training programmes tailored to the operating conditions of GRZD are available.

The renewal system by UK (Platow Crane) contains rail changing when the panels are put down. The standard length of 25 m will be changed to long welded rails of 800 m. These rails could be changed by a hydraulic rail threater which accelerates and facilitates the operating cycles. Therefore, to the above listed engines the following machines are to be added:

hydraulic rail threater type MPR, hydraulic controlled turntable and off tracking equipment -power 6 t- price/unit 0.550 million US$

Three of them have to be purchased and located at the Permanent way workshops The total would amount to **1.650 million US$.**

3.1.2.4.1 Lining of the track between Khashuri and Zestafoni

The critical section of the main line is located between Khashuri and Zestafoni where gradients of 29‰, curves with radii of 150 m -200 m, tunnels and bridges on double and single line commonly appear. GRZD planned three variants to improve and to rehabilitate the lining of the single track sections. An official approval for the planned project has been given and the approval for variant 1 has been obtained. Section 1 Zestafoni - Kharagauli km 2338-2343 =5,000 m, section 2 from station Marelisi km 2347 - 2352.6 = 5,600 m. The gradients on the planned sections are max. 18,5‰, the least radius in section 1 = 600 m, in section 2 = 400 m. If the traffic on the Trans-Caucasian Line increases, the section between Khashuri and Zestafoni will become of major importance. The cost estimation for section 1 amounts to 30,000 million US$, for section 2 to 47,000 million US$. Project documents are available. The costs for the planned projects are not included in the financial pre-feasibility calculations.

3.1.2.4.2 Renovation and modernisation of the quarry (Durnuki plant)

Another important weakness is the quarry (Durnuki plant) which has had most of its important equipment either vandalised or destroyed. The quarry is unable to produce the different fractions of grain in sufficient quantity and quality, especially ballast and others for prefabricated concrete parts. A fully functional quarry will be the precondition for the production of high quality ballast for the permanent way and all required grain sizes for the production of prefabricated concrete parts as well as for prestressed concrete sleepers. An estimation given by the GRZD authorities amounts to 1.0 million US$ and includes the following:

new crusher and riddle systems
pipes and conveyor belts
washing equipment to clean the broken stones from dust and filler
bulldozers, excavators and trucks
other materials for the renovation of offices and social rooms and.
to complete a construction hall for prefabrication of concrete parts.

3.1.2.4.3 Own prestressed concrete sleeper production

The necessity to import all track materials increases the expenditure for track maintenance and track renewal. With a modern well equipped quarry, GRZD would be able to set up its own prestressed concrete sleeper production with a new kind of sleeper made according to the European standard sleeper design and fastenings.

Possible economic solutions for production of concrete sleepers for all Caucasian countries are investigated within the TRACECA project „Joint venture(s) for the Caucasian Railways". The costs for a concrete sleeper plant are not included in the financial pre-feasibility calculations.

3.1.2.4.4 Sleeper impregnation plant

The sleeper impregnation plant is working well despite the general situation. Before the collapse of the Soviet Union, the impregnation plant located at Gori, produced the wooden sleeper for all Caucasian countries. This former situation should be restored. The equipment is sufficient for the wooden sleeper needs of all Caucasian railway organisations. The renewal and rehabilitation measures stopped some time ago should be continued in view of:

finishing of the impregnation hall,
environment protection measures and
rehabilitation of the administration building and social rooms.

The costs are estimated at about 200,000 US$.

3.1.2.5 Definition of training needs

Professional skill is the most important requirement in order to achieve quality and high performance in mechanised track works, track renewal and track maintenance. Special skill is required in 3 fields

- **economical track renewal and maintenance system**
  Required personnel will be selected from the general management leadership.
  The training contents:
  Railway organisation and handling of computer aided systems to organise long and short term track renewal and track maintenance systems in economical, operational and technical conditions used in Western countries along with work studies, work programmes, time schedule of site completion, fabrication and maintenance of continuously welded rails, updating of engineering manuals and instructions, competitive procurement procedures, computerising of track inventory and constructions, financial requirements, financial program and budget planning for short and long term track maintenance and track renewal programs.
- **operation of new track engines**
- **maintenance of machines**
  The new track engine generation needs intensive operation training and servicing staff and is thus gaining greater importance for the successful and economical operation of the machines. The training programme will help the machine crews to operate the engines at a high performance level. The objectives of the training programme will be to inform and to teach the leaders of machine crews how to operate the engines to get the best results and a long service life. The training should be carried out by seminars of several 1 - 3 months periods depending on the basic knowledge. The programme contains theoretical and practical parts and also includes visits to construction sites. Required are skilled personnel for machine operation, leader of machine crews and members, skilled service specialists for machine maintenance, mechanics, hydraulics and electricians.

Approximately 40 people are expected to participate in the training programs and the costs are estimated at up to 500,000 US$.

3.1.2.6 Financial pre-feasibility

The financial pre-feasibility assessment describes a general view of the expenditure which is necessary to carry out the rehabilitation of the investigated line described above. The cost estimations are divided into six parts (see Annex 3.1.2-9).

Part 1 - Track and switch renewals
Part 2 - District equipment
Part 3 - Equipment and engines for permanent way workshop
Part 4 - Bridge renewal and major repair
Part 5 - Quarry equipment and impregnation plant
Part 6 - Training needs

The main part would be the expenses to renew and to maintain the investigated line. Preconditions are equipment, tools and engines so that placing of orders for these items have first priority. The recommended engines and equipment represent the basis to achieve the full scheduled maintenance system by a new machine generation. The cost estimation for track renewal is based on a calculation compiled by AGZD in June 1996 and is also used for GRZD (see Table 3.1.1-9 and 3.1.1-10). Districts and permanent way workshop's equipment is based on the price level of Western manufactures. Rehabilitation costs of bridges are given by GRZD and correspond with the project documents that are in preparation.

The unit prices of the above mentioned track materials do not correspond with Western price levels. The calculated costs per km of track renewal are rounded up to 240,000 US$ in the financial pre-feasibility assessment.

Table 3.1.2-8 below summarises the investment costs for rehabilitating the track line border point AGZD - Tbilisi - Poti and amounts to a total of **292.683 million US$.**

Table 3.1.2-8: Summary of financial means to rehabilitate the track line border point to AGZD - Tbilisi - Poti

No	Designation	Amount in million US$		
		priority 1	priority 2	total
1	2	3	4	5
1	Track and switch renewals	72.140	80.720	152.860
2	Equipment of districts	7.715	2.980	10.695
3	Permanent way workshop	10.034	9.914	19.948
4	Bridge renewals and major repairs	12.140		12.140
5	Quarry equipment, and sleeper impregnation plant	1.200	-	1.200
6	Training needs	0.500		0.500
	Total	**104.229**	**93.614**	**197.343**

The complete overview is to be found under Annex 3.1.2-9.

The afore-mentioned measures (items 1-6) will be carried out according to the following schedule, based on the GRZD track and bridge renewal capabilities:

- Item 1: Track and switch renewal, starting phase 84 km + 40
  Switch units in the following year 120 km + 90
  Switch units in the following year 120 km + 90
  Switch units in the following year 120 km + 90
  Switch units in the following year 120 km + 90
  A replacement of the switch sleepers is involved in the switch units. Subsequent to implementing track renewal measures on the Poti-Tbilisi-border point to AGZD line the track will be maintained and renewed according to plan which is fixed with 25 km of track and 40 switch renewals per year. The expenses of about US$ 7.6 million on the planned maintenance shall be then covered by GRZD on the basis of its profit, thus not being included in the rehabilitation program.
- Item 2: Equipment for districts, starting phase: inventory taking and 33,3 % of the order, the remaining 66,6 % in the following year.
- Item 3: Permanent way workshop, outfitting is imperative to carry out track laying and will have to be done in the starting phase and the following 2 years.
- Item 4: Bridge renewals and major repairs, starting phase + 4 years.
- Item 5: Quarry equipment and impregnation plant, without delay, to make available ballast for carrying out the comprehensive measures of track renewal and ensure that the sleeper impregnation plant will be in a position to effectively impregnate wooden sleepers.
- Item 6: Training without delay, modern management in track maintenance and renewal is absolutely necessary and should be provided before starting comprehensive rehabilitation.

The following Table 3.1.2-9 shows the annual investment required for the rehabilitation of the afore-mentioned line. The schedule is based on the rebuilding capacities available in the local enterprise if it will be possible to purchase the necessary equipment and machinery.

Table 3.1.2-9: Investment flow in annual rates for the rehabilitation of the Poti-Senaki-Tbilisi-border point to AGZD line

no.	item	1998	1999	2000	2001	2002
		1,000 US$	1,000 US$	1,000 US$	1,000 US$	1,000 US$
1	2	3	4	5	6	7
1	track renewal 84,+ 4 x 120 km	20,160	28,800	28,000	28,800	28,800
	switch renewal 40 + 4x90 switches	1,600	3,600	3,600	3,600	3,600
	crossing timber sets 3 x 50	500	500	500		
2	district equipment 33.33% of 10,695 66.66% of 10,695	3,565	7,130			
3	permanent way workshop	5,000	7,474	7,474		
4	bridge renewals total 12,140	1,500	2,660	2,660	2,660	2,660
5	quarry equipment	1,000				
6	impregnation plant	200				
7	training	500				
	As of 2003 a planned track maintenance is effected					
	Total 197,343	**34,025**	**50,164**	**43,034**	**35,060**	**35,060**

3.1.2.7 Conclusions concerning the rehabilitation of the permanent way between border point AGZD - Tbilisi - Poti

The investigated line demonstrates a large backlog of fully scheduled track maintenance and a systematically annual track renewal. Over the last seven years, GRZD services have been forced to undertake an ever increasing number of urgent repairs on separate small line sections. This method has created a sort of patchwork on the line that prevents a systematic approach to structural maintenance and renewal policy which is required to assure safe traffic and homogeneous quality on all line sections. The main evident defects concern the following basic principles:

- poor condition of track subgrade, irregular profile and slope, insufficient ground base and draining capacity adapted to the existing subsoil quality
- low stability of the ballast bed due to the lack of side paths with the result that the sleeper ends are not supported by ballast and consequently lead to defective rail fastenings and damages on wooden and concrete sleepers.
- tracks laid in cutting areas are not properly drained.
- the contact wheel/rail has to be regular and continuous to avoid or to reduce dynamic corrosions.

It is obvious that most of the recorded defects concern these basic principles and are the reason for the rather low degree of reliability. Furthermore, it is impossible to ensure traffic safety on the present basis even if many controls are carried out. It is necessary to abandon the Russian rules and maintenance procedures and to introduce modern maintenance systems and procedures.
The main improvements to the above mentioned defects are as follows:

- the foundation of the track has to be constructed carefully, respecting the slope and side paths imposed by a cross-section type.
- new prestressed concrete sleepers including new rail fastening elements.
- washed broken stones as ballast with high resistance taking into consideration the prescribed grain size.
- to introduce the technology of continuous long welded rails in track lines as well as in switch sections. Knowledge of aluminothermic rail welding has to be acquired.
- scheduled full maintenance in both track and constructions

The different divisions and their calculated costs are listed in Annex 3.1.2-9 which shows also the priorities of the measures.

Annexes

Annex 3.1.2-1	Survey of the track line border point AGZD - Tbilisi - Poti.
Annex 3.1.2-2	List of bridges located on the investigated line
Annex 3.1.2-3	Organisation structure of permanent-way general management
Annex 3.1.2-4	Organisation structure of the district Tbilisi.
Annex 3.1.2-5	Stock and shortage of essential equipment of all districts.
Annex 3.1.2-6	Organisation structure of permanent-way-work-shop Tbilisi.
Annex 3.1.2-7	List of permanent speed restriction sections.
Annex 3.1.2-8	Inventory of track engines of GRZD permanent way workshop.
Annex 3.1.2-9	Cost estimation of track renewal and associated equipment.

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Chapter 3 Technical Pre-feasibility

3.2 Rolling stock
3.2.1 Azerbaijan

3.2.1 Rolling stock of Azerbaijan State Railways

3.2.1.1 Existing situation

3.2.1.1.1 The locomotive fleet of AGZD

A list of abbreviations used in this chapter can be found at the end of this section.
The locomotive inventory of AGZD amounts to a total number of 229 electric engines of which 226 are line locomotives. This is divided into 183 VL-8 (79.9%), 43 VL-11M (18.7%), and the 3 electric shunting locomotives, 1 VL-22 and 2 VL-23. The different types of locomotives and their location in the locomotives shops (depots) are shown in Annex 3.2.1-1. The age structure of the electric locomotives given in Annex 3.2.1-2 shows that all VL-8 are more than 30 years old, whereas the VL-11 are 5 - 7 years old.
The design of the types VL-8 and VL-11 is characterised by outmoded solutions for controlling systems and the lack of modern components and elements. Annex 3.2.1-3 includes a brief technical description of the most important electric locomotives VL-8, VL-10 and VL-11. All these locomotive types are double-section units.
Of all 143 electric locomotives type VL-8 and VL-11 in operation 94 locomotives (66%) should be subject to middle repair with lifting (TR-3) to comply with the rules for service times for locomotives. As a result of their technical condition 92 VL-8 older than 34 years should be scrapped. The question of replacement can be only investigated later within the context of future locomotive requirements.

3.2.1.1.2 Workshops for locomotives

The maintenance system of AGZD for locomotives includes inspections (TO-1, TO-2, TO-3), overhauls (TR-1, TR-2, TR-3) and main repairs (KR-1, KR-2). The periods of these repairs depend on the running kilometres.
The different maintenance types are shown in the following table:

Table 3.2.1-1: Locomotive maintenance types

abbr.	running kilometres	(approximate time in operation)	type
TO-1			daily service
TO-2			weekly inspection
TO-3	11,000 km	monthly	monthly inspection
TR-1	22,000 km	after 2 months	first overhaul
TR-2	150,000 km	after 1.5 year	second overhaul
TR-3	300,000 km	after 3 years	overhaul with lifting
KR-1	600,000 km	after 6 years	first main repair
KR-2	1,200,000 km	after 12 years	general repair

Only 3 out of the 5 locomotive depots of AGZD perform maintenance services for the Baku - Poti - Corridor: **TshD**[1] **Baladshary** (121 locomotives), **TshD Beyuk-Shtshor** (32 locomotives) and **TshD Gyandsha** (76 locomotives).

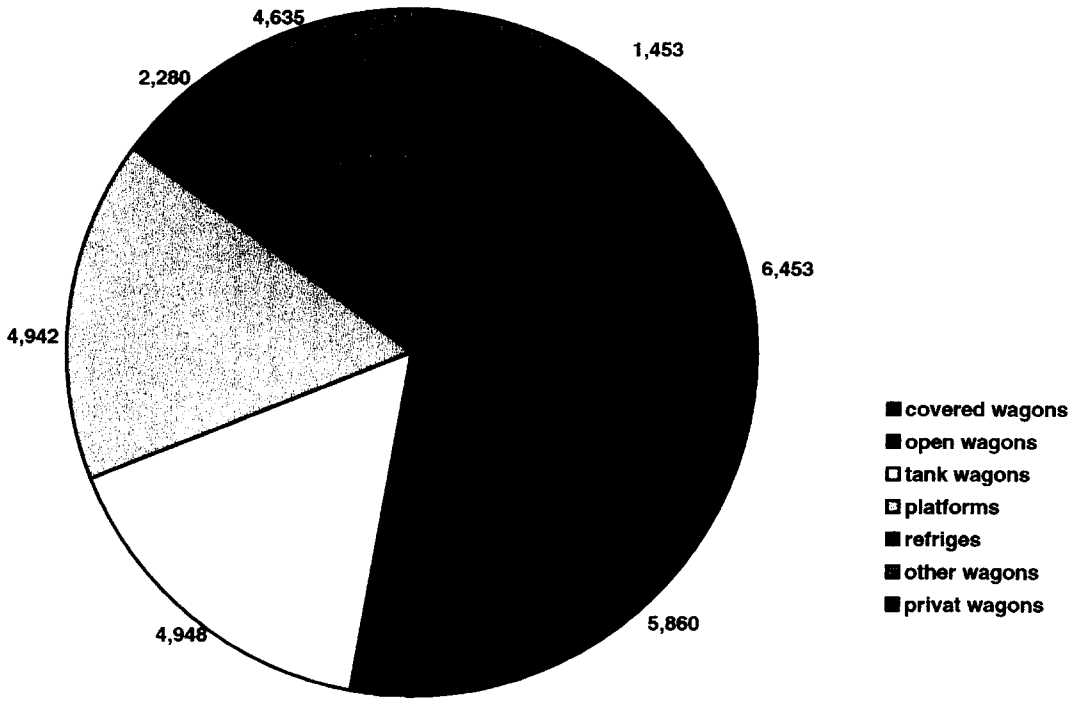
[1] TShD - locomotive depot

None of these depots is equipped with heavy cranes or lifting installations to carry out the "overhaul with lifting" here referred to as TR-3. There does not exist a workshop for the main repair categories KR-1 and KR-2.
In the past AGZD used maintenance capacities of Georgia, Russia and Ukraine for TR-1, KR-1 and KR-2 . But a part of this way of cooperation has been blocked since 4 years. Thus, in May 1996 the backlog in locomotive maintenance was stated with 94 locomotives requiring a TR-3 maintenance, 86 a KR-1 and 24 a KR-2 maintenance as shown in Annex 3.2.1-1.

3.2.1.1.3 Wagon stock

The wagon inventory of AGZD amounts to a total number of 30,571 wagons, mainly with 2-axle bogies (approximately 22 t tare weight and 65-70 t load capacity). Additionally, a small number of 8-axle (tank) wagons exists (44 tons tare weight, 105 tons load). All wagons are equipped with semi-automatic central buffer couplers. The distribution of the different types is shown in the graphic below.

Fig. 3.2.1-2: Wagon inventory stock



The detailed inventory in figures is shown in Annex 3.2.1-4.
The age structure of the wagons is not available from AGZD as the data for all freight wagons used to be centrally processed in Moscow. Up to the present no inventory was carried out to determine the actual technical condition. Irrespective of this fact the following statements briefly describe the situation (see NETHCONSULT report, TACIS project "Azerbaijan Railways Management and Organisational Structure):

- The age of the wagons is rather high, i.e. more than 20 years, except covered and some special wagon types for bulk goods and containers.
- Wooden material is still being extensively used for doors, walls, floors and roofs.

– A small number of bogies is still equipped with sliding bearings for axle-boxes.

3.2.1.1.4 Workshops for wagons

The maintenance system of AGZD for wagons includes inspections (TO, OR, TR) and repairs (DR, KR). For special wagons with unloading or other special equipment the periodic inspection (TR) is again divided in TR-1 and TR-2. The TR-2, DR and KR maintenance services are carried out periodically intervals. The maintenance types are shown in the table below.

Table 3.2.1-2: Wagon maintenance types

abbr.	type
TO	daily inspection in trains
OR	daily inspection and accidental repair outcoupled from trains
TR, TR-1	heavy damages, repair in depots
TR-2	after 3 months, regular inspection
DR	yearly repair after one or two years in depots
KR	main repair after 8, 10,11 or 12 years in workshops

All 5 wagon repair workshops of AGZD perform TR and DR maintenance services for the Baku - Poti - Corridor: **VTshD**[2] **Baladshary**, **VTshD Kishli**, **VTshD Kasi-Magomed**, **VTshD Gyandsha** and **VTshD Aliat**. Furthermore, AGZD posses two main wagon factories

a) **BWRS** - Baku Wagon Repair Factory which is specialised in tank wagon repair (KR and heavy repairs) and

b) **BWWSS** - Baku Wagon Washing and Steaming Station which is specialised in tank wagon services.

In May 1996, services included 693 wagons of annual repair (DR), 1,420 wagons of occasional repair (TR), 42 tank wagons for main repair (KR), and 1,440 washed tank wagons. Details of the actual number of wagons repaired are shown in Annex 3.2.1-5.
Before the general political changes the KR maintenance of all other wagon types was carried out by the different specialised wagon repair factories in the different republics of the former Soviet Union. Over the last 5 years for this part of wagon stock (with exception of tanks), i.e. 20,142 units, there was not carried out any KR, the theoretic backlog of KR now is to be estimated with about 10,070 wagons.

Given that at present the AGZD has far too many wagons, the question can be posed whether in practice the maintenance should depend on time in future. As the wagon stock of AGZD even in the future should meet the requirements of the international traffic within the CIS countries, the question of changing the maintenance rules depends on respective agreements between all the Railway administrations concerned. Concerning the technical point of view the roller bearings and the brake installation as valves and cut-off cocks and, in case of special wagons as tanks, all discharging gates not used for a longer period are sensitive details of

[2] VTshD - wagon depot

wagons. Moreover, these sensitive details lose their technical availability dependent on time in the case of not using them.

The time-depending KR maintenance cycle of tanks depends on the wagon type and vary between 8 and 12 years as shown in the following table.

Table 3.2.1-3: KR maintenance cycle of tanks

tank wagon type	KR after years
petrol tanks constructed up to 1985	8
petrol tanks constructed after 1985	12
8-axle petrol tanks	11
tanks for viscous liquids	8

3.2.1.2 Bottlenecks of AGZD rolling stock

3.2.1.2.1 Locomotive bottlenecks

The problems that AGZD encounters concerning the number of required locomotives by daily train formation, train performances and locomotive maintenance can be seen in the statistics for damaged locomotives as well as in the list of equipment needed for the locomotive shops. The problems are not quite obvious due to the actual low transport volume.

Locomotive fleet transport capacity

The AGZD fleet has 229 locomotives of different types. In May 1996, the number of locomotives damaged each day reached an average of 83 locomotives, approximately 36% (see Annex 3.2.1-1).

Each type of locomotive is differently affected by damages (see Annex 3.2.1-6). As a result of these facts, it can also be said that approximately 146 locomotives, i.e. 64%, are available for operations.

Details of the operating locomotives are shown in the table below.

Table 3.2.1-4: Locomotives under operation

type of locomotive	operating in %	number of locomotives
VL-8	59	108
VL-11M	81	35
VL-22	100	1
VL-23	100	2

Taking into consideration the distribution of the different types of locomotives to the depots on the line from Baku to Beyuk-Kyassik the number of available trains per day can be estimated as follows.

Table 3.2.1-5: Available trains per day

depot	operating number of locomotives	locomotives turn-back to the depot	available trains per day
Baladshary	80	1.4 days	57
Gyandsha	48	1.4 days	34

The train operating system uses a method whereby the train is handed over from one depot region to the next like a relay. The effect of this method is that each locomotive has a fixed crew, i.e. engine drivers and assistants.
Thus, the possible capacity of trains on AGZD corridor is at present limited to a minimum of 34 trains per day in one direction. If the speed restrictions were cancelled by 2010 the turn back of the locomotives to the depots would be reduced to 0.9 days. In this case the possible train capacity would be limited to 53 trains per day in one direction.

Locomotive stock maintenance
As mentioned above the main part of the locomotive fleet consists of the old fashioned VL-8 type (79.9%). The age of this type is the main cause of the generally bad maintenance situation for locomotives. The different maintenance measures for TO-1 to TR-2 are carried out in locomotive depots owned by AGZD. Due to the lack of a workshop for main categories of locomotive repair in Azerbaijan (KR-1 and KR-2), AGZD used foreign workshops in the Ukraine, Georgia and Russia and had to pay for these services in foreign currency. The price for these foreign services is approx. US$ 200,000 for KR-1 and US$ 300,000 for KR-2 according to information by the AGZD management. Due to
- the political insulation with respect to the northern neighbouring countries
- the delay of spare parts and
- the lack of funds to pay for the main repair

presently only 143 line locomotives are in operation while 83 locomotives are out of order.

37 (86%) out of the total number of 43 electric locomotives of type VL-11 should be overhauled with lifting (TR-3) to comply with the rules for running kilometres of locomotives. In order to make up for the backlog in maintaining the locomotive fleet, the following repairs should be carried out:

Table 3.2.1-6: Locomotive backlog repair volume

locomotive type	TR-3	KR-1	KR-2
VL - 8	57	86	24
VL - 11	37	0	0

Due to the frequency of the TR-3, which is carried out approx. every 3 years, one of the urgent questions is how to create the capacities for TR-3 in order to increase the level of technical reliability. As 92 VL-8 type locomotives are to be scrapped due to their service life (35 years and older), it is therefore not necessary to carry out the KR-2 for this type (24 locomotives). The number of VL-8 / KR-1 repairs could be limited to 18.

Some figures regarding the present situation of technical reliability with respect to the locomotive fleet (see Annex 3.2.1-6) show, that in 77 cases locomotives broke down during operation in the first quarter of 1996. The main reasons were faults in the sliding contacts in 16 cases (21%), followed by insulation ruptures of the armatures in 12 cases (16%). In general, the different types of armatures seem to be the weak points as their share amounts to 33 cases (43%).

3.2.1.2.2 Wagon stock bottlenecks

The problems that AGZD always encounters with its wagon stock during daily train operations include loading, handling and maintenance. This can be seen in statistics on damaged wagons, in the list of equipment needed for the wagon repair shops, and in the list of required spare parts. The problems are not so obvious due to the present low transport volume.

Wagon stock transport capacity

The overall AGZD fleet, without private units, has a total number of 29,118 wagons of different types. In April 1996, the present number of damaged wagons reached an average of 18,671 wagons per day, i.e. approx. 61%. According to the wagon type different levels of damages occur (see Annex 3.2.1-7). This summary underlines the general high level of damaged freight wagons, as an average of 68% was damaged per day during the last 4 months.

Particularly involved were covered wagons with 99% damaged, refrigerators with 88% and platforms with 85%. The daily damage of other types amounted to approximately half of their total number. Only the average damage levels of grain wagons with 30% and container wagons with 38% were lower. As a result of these facts the operational freight wagon stock can be estimated as being 10,370 wagons, i.e. about 35%.
Details of the fleet in operation are shown in the table below.

Table 3.2.1-7: Operating wagon stock

type of wagon	in operation in %	number of wagons
covered wagons	1	65
platforms	15	741
open (coal) wagons	53	3,106
tank wagons	56	2,771
refrigerators	12	274
other wagons	40	786
container wagons	62	342
cement wagons	38	317
grain wagons	70	900

In order to estimate the number of wagons available per day it is necessary to take into consideration the percentage of wagons not available due to technical reasons or repairs, i.e. DR and KR. Normally this factor can be estimated as being 10%. Investigations made by AGZD have also confirmed this factor as being 10%.
In order to estimate the actual possible daily freight volume which can be loaded the wagon turn-round was taken into consideration.

The wagons turn-round was calculated as being the total time the wagon needs to turn round from the beginning of one loading procedure to the beginning of the next one. This figure depends on the different specifications of the given railway system and varies according to each type of wagon. Usually, these figures can be obtained from the railway administration concerned.
For the different types of freight wagons the actual possible daily freight which can be loaded can be divided as follows.

Table 3.2.1-8: Possible daily freight volume

type of wagon	number of wagons	wagons turn-round	daily available wagons to be loaded	load of wagon in tons	daily possible load in tons [3]
covered	59	30	2	42	84
platforms	667	14.5	46	50	2,300
open (coal)	2,759	22	125	63	7,900
tank	2,494	9.6	260	57	14,808
refrigerator	247	11	23	40	920
container	308	14.5	21	62	1,302
bulk cement	285	16	18	62	1,116
bulk grain	810	8	101	42	4,242

The actual daily total volume of possible new loading capacities using the available stock can only reach a level of approximately 32,672 tons because only 7,629 wagons are taken into consideration[4].
As a result of the overall wagon availability 303 trains could be operated daily including approximately 17 trains from the possible new daily loading, every train consisting of approximately 30 wagons and a load capacity of approximately 1,922 tons. If the number of wagons was limited to 22 per train then the daily number of trains would be increased to 413 trains including 23 trains from the possible new daily loading, every train with a load capacity of approx. 1,421 tons.
This relatively low level of new daily loading capacity based on the available wagon fleet reflects the long wagon turn-rounds in the first 7 months of 1996 according to the information received from AGZD. In this context it is important to mention that the main reason for the long wagon turn-round is the low train speed due to the speed restrictions on all sections of the main line.

Wagon stock maintenance

The question can be posed about the usefulness of a discussion concerning wagon stock maintenance because the operational stock is presumably far larger than the presently needed stock. The aim here is to show the difference between the volume of a regular wagon maintenance and the maintenance volume for the stock at present only needed in order to work out available weaknesses.
As shown in the previous page the AGZD wagon stock contains 29,118 units. In order to maintain this stock it will be necessary to carry out 19,306 middle repairs

[3] The estimation was carried out by using a loading factor depending on the different wagon types.
[4] This estimation does not consider 1,477 so called "other" wagons not mentioned in the table above as under this term reference is made to a collection of special types with quite different parameters.

(DR) and 2,735 main repairs (KR)[5] per year. The division of the wagons into the different types is shown in Annex 3.2.1-8.
For the actual operating number of wagons there will be an annual requirement of 6,301 wagons for DR and 761 wagons for KR.
By comparing these figures with the actual performed repairs it is possible to use the following matrix to show the present maintenance situation.

Table 3.2.1-9: Possible monthly wagon maintenance

kind of maintenance	DR	KR
maintenance carried out in May 1996	693	42
actual monthly demand needed for the operating stock	228	63
estimation of capacity	sufficient	not sufficient
monthly demand needed for the inventory stock	1,609	228
estimation of capacity	not sufficient	not sufficient

The first urgent problem is the delay of the capacities for carrying out the main repairs (KR) of all wagon types (without tanks). The second problem is the occasional urgent repair of the 19,806 damaged wagons located on sidings along the main line. This question is to be investigated at a later date together with an undertaking to forecast the future wagon stock demand .

3.2.1.3 Definition of the volume of repair works

3.2.1.3.1 Repair works of the locomotives

In order to deal with the problems the locomotive service encountered during the last few years it is necessary to define the required locomotive demands followed by investigations as to how to develop the maintenance capabilities.

The future locomotive stock requirements

The required number of locomotives depends on the future train service demands on the corridor's main line which was defined on the basis of the traffic forecast optimistic and pessimistic scenarios. It has to be noted that the figures for the train load are stated above. The figures concerning the daily required freight wagon stock which were used as the basis for the forwarding train calculation are given in Annexes 3.2.1-14 to 3.2.1-17. In this context it was presumed that the infrastructural improvements will steadily decrease the speed restrictions which will result in even shorter and shorter wagon turn-rounds as can be seen in the annexes mentioned above. The freight traffic on the corridor's main line is a part of the total operations.

Furthermore, it was taken into account, that the locomotive's return to the depots is shortened from at present 1.4 days to 0.9 days in the year 2010. The results for both directions of the corridor East-West and West-East implies that the demand for locomotives on the corridor will be increased from 22 to 62 in the optimistic case, but

[5] This does not consider the so called "other" wagons (see footnote 2)

in the pessimistic case from 21 to 36 only, based on the fact that the westbound relation is the dominating one. An overview is to be found under the following table.

Table 3.2.1-10: Locomotive demand for freight train service on the corridor

number of locomotives horizons		1998	2000	2010	2015
for westbound traffic	optimistic	22	57	55	62
	pessimistic	21	31	32	36
for eastbound traffic	optimistic	6	10	10	12
	pessimistic	6	9	8	10

A complete summary with a split into the different corridor's sections concerned is given in Annexes 3.2.1-9 and 3.2.1-10.
Now the demand for operating passenger trains was taken into consideration and therefore, the respective locomotive demand was estimated. The result was a demand of locomotives for passenger train service increasing from 2 in 1998 to 11 in 2015. The respective development is shown in the following overview.

Table 3.2.1-11: Locomotive demand for passenger train service

horizons	1998	2000	2005	2010	2015
locomotive demand	2	2	8	8	11

Combining the two demands the required operating locomotive stock for the corridor main line will grow in optimistic case from 24 locomotives in 1998 to 73 in 2015 as shown in the table below. For the pessimistic forecast the requirement of locomotives will grow from 23 locomotives in 1998 to 47 in 2015.

As shown in the following table the complete phasing grow of the required operating locomotive demand is developed to the inventory stock demand and then compared with the present available locomotives and with a proposed scrapping programme[6] in order to achieve an overview concerning the future needed procurement.

[6] The scrapping programme is based on actual situation of technical condition and the age structure of locos.

Table 3.2.1-12: Development of the locomotive stock for the corridor's need

horizons	1998		2000		2005		2010		2015	
	opt	pes	opt	pes	opt	pes	opt	pes	opt	pes
loco demand for trains	24	23	59	33	65	39	63	40	73	47
needed loco inventory[7]	29	28	71	40	78	47	76	48	88	57
loco present stock	226	226	188	158	134	64	134	50	96	60
out of order	83	83	45	15	0	0	0	0	0	0
availability of loco stock	143	143	143	143	134	64	43	50	96	60
need of main overhaul	38	38	54	0						
scrapping (1) of loco[8]	38	68	54	94	0	0	0	0	0	0
scrapping (2) of loco[9]	0	0	0	0	0	21	91	0	0	0
procurement of loco (1)[10]	0	0	0	0	0	7	53	10	0	0
procurement of loco (2)[11]	0	0	0	0	0	0	0	0	14	0

In optimistic case the programme to scrap 92 VL-8 type until 2004 should be realised by annual rates shown in the following table. In 2010 scrapping the remaining 91 VL-8 locomotives shall start.
In pessimistic case the scrapping programme should start with 68 VL-8 until 2000 followed by further 94 V-8 until 2004. In this case the remaining 21 VL-8 should be scrapped in 2005.

Table 3.2.1-13: Locomotive scrapping programme

	optimistic		pessimistic	
year	number	estimated costs	number	estimated costs
1998	6	US$ 1,500	10	US$ 2,500
1999	16	US$ 4,000	30	US$ 7,500
2000	16	US$ 4,000	28	US$ 7,000
2001	14	US$ 3,500	25	US$ 6,250
2002	14	US$ 3,500	23	US$ 5,750
2003	13	US$ 3,250	23	US$ 5,750
2004	13	US$ 3,250	23	US$ 5,750
2005			21	US$ 5,250
2010	15	US$ 3,750		
2011	20	US$ 5,000		
2012	25	US$ 6,250		
2013	20	US$ 5,000		
2014	11	US$ 2,750		
cost total		**US$ 45,750**		**US$ 45,750**

In both cases the scrapping cost will amount to a total of US$ 45,750.

[7] The reserve factor used is 1.2.
[8] here scrapping without replacement by new locos.
[9] here scrapping combined with procurement of new locos.
[10] for replacement
[11] for extension

In optimistic case a procuring programme in order to replace the remaining 91 VL-8 type by 53 new locomotives should start in the year 2010 with the following rates and corresponding costs. Furthermore, for extending the locomotive fleet 14 new locomotives are to be procured in 2015. In pessimistic case the procurement is limited to 10 locomotives in order to replace a part of the scrapped ones.

Table 3.2.1-14: Locomotive procurement programme[12] for the corridor

	optimistic		pessimistic	
year	number	estimated costs[13]	number	estimated costs
2006			7	US$ 28 million
2010	6	US$ 24 million	10	US$ 40 million
2011	7	US$ 28 million		
2012	12	US$ 48 million		
2013	14	US$ 56 million		
2014	14	US$ 56 million		
2015	14	US$ 56 million		
cost	total	US$ 268 million		US$ 68 million

The cost's total for locomotive procurement will reach US$ 268 million in optimistic case whereas US$ 40 million will be reached in pessimistic case.

The future maintenance capabilities for locomotives

As shown above the locomotive maintenance system is based on a general repair after 1,200,000 running km which means after approximately 12 years in service (AGZD conditions). Therefore, an annual number of 12 locomotives supplies the basic figures for the different maintenance levels: 70 TO-3, 63 TR-1, 4 TR-2, 2 TR-3, 1 KR-1 and 1 KR-2. The total number of different maintenance types required should achieve the following annual values.

[12] Replacement: 2010 / 2014
Extension: 2015

[13] The price of one 5,000 kW locomotive is estimated with USD mln 4.0.

Table 3.2.1-15: Future needed main overhauls and regular maintenance volume for corridor's locomotives and respective costs

year	type	number	TO-3	TR-1	TR-2	TR-3	KR-1	KR-2	yearly costs in US$ mill.
1998 opt	VL-8						**15**		1.500
1998 pess	VL-8						**23**		2.300
1999 opt	VL-8						**15**		1.500
1999 pess	VL-8						**23**		2.300
2000 opt	VL-8						**25**		2.500
2001 opt	VL-8						**29**		2.900
2000 opt	VL-8	91	531	478	30	**15**	**0**	**0**	1.001
	VL-11	43	251	225	14	**7**	**4**	**4**	1.075
	total								**2.076**
2000 pess	VL-8	21	123	110	7	**4**	**0**	**0**	0.231
	VL-11	43	251	225	14	**7**	**4**	**4**	1.075
	total								**1.306**
2005 opt	VL-8	91	531	478	30	**15**	**0**	**0**	1.001
	VL-11	43	251	225	14	**7**	**4**	**4**	1.075
	total								**2.076**
2005 pess	VL-8	7	41	37	2	**1**	**0**	**0**	0.077
	VL-11	43	251	225	14	**7**	**4**	**4**	1.075
	total								**1.152**
2010 opt	VL-8	53	309	278	18	**9**	**0**	**0**	0.583
	VL-11	43	251	225	14	**7**	**4**	**4**	1.075
	total								**1.275**
2010 pess	new	17	50	44	3	**2**	**1**	**1**	0.425
	VL-11	43	251	225	14	**7**	**4**	**4**	1.075
	total								**1.500**
2015 opt	new	53	155	137	9	**4**	**2**	**2**	1.325
	VL-11	43	251	225	14	**7**	**4**	**4**	1.075
	total								**2.400**
2015 pess	new	17	50	44	3	**2**	**1**	**1**	0.425
	VL-11	43	251	225	14	**7**	**4**	**4**	1.075
	total								**1.500**

For the optimistic case 14 new locomotives are still to be procured in 2015, afterwards to be considered in the maintenance scheme and to be reckoned with respective costs. Moreover, as shown above AGZD should reckon with yearly locomotive maintenance costs of US$ mill. 2.076 from 2000 to 2009, of US$ mill. 1.275 from 2010 to 2014 and of US$ mill. 2.400 in 2015. The respective costs of the pessimistic case can be found in the above table, too.

To cover the annual demand of KR-1 and KR-2 AGZD should keep the traditional way of co-operation with other Railway administrations, mainly with the neighbouring Georgian Railway (GRZD). It is urgently required to organise the return of the repaired locomotives from the repair shops in Russia and Georgia (2 VL-11 and 2 VL-8) at a cost of US$ 1.2 million.

The capabilities for locomotive maintenance systems with AGZD should be improved step by step. First of all the **Baladshary Locomotive Depot** should be upgraded with new equipment for lifting the locomotives to carry out the TR-3 repair level on 2 repair places. This will take place 24 times per year to cover the necessary demand. For this reason it is necessary to procure 16 mechanical lifting jacks type UDP- 160. With this improvement AGZD can annually reduce the backlog of TR-3 by 7

locomotives. The costs for this short term measure to be realised in 1998 are estimated at US$ 160,000.

The traction motor of locomotives is frequently damaged. So some small equipment will be needed for the quick repair of this important component as a middle term measure to be realised by the year 2000:

- Inductive warming up device for the gear 10 pieces
- Hydraulic press for the gear - A 170.01.00 - 5 pieces
- Tightening device for the gear 15 pieces
- Transportable device for pushing through with 12 kW 4 pieces
- Hydraulic jack with 25 tons 10 pieces
- Hydraulic jack with 10 tons 20 pieces.

The procurement costs for this equipment are estimated at US$ 0.75 million.

Besides the general problems concerning maintenance equipment the lack of components and spare parts for locomotives is also one of the main problems in trying to maintain normal operations. The amount of components and spare parts required is listed in Annexes 3.2.1-11 and to be procured in 1998 and 1999. The urgently required material and elements are listed in Annex 3.2.1-12 and to be procured in 1998 and 1999. In order to overcome the maintenance backlog the financial estimate for main components which are urgently required is calculated as being US$ 1.175 million. The financial demand for material and elements is calculated as being about US$ mill. 2.045.

3.2.1.3.2 Repair works of the wagon stock

In order to solve the problems which the wagon service encountered during the last few years it is necessary to define the required wagon demands followed by investigations as to how maintenance capabilities can be developed.

The future wagon stock requirements

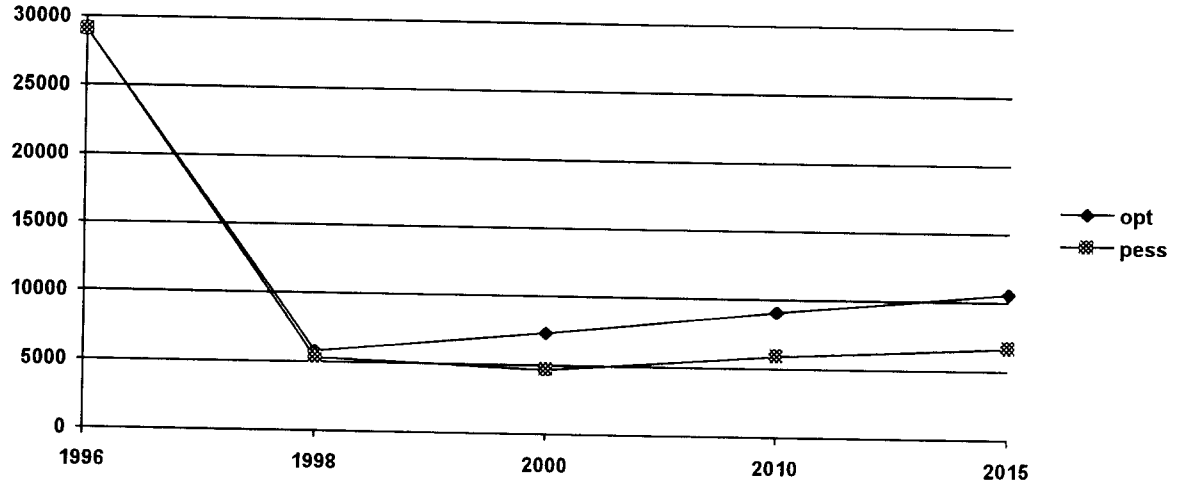
The number of wagons required depends on the future demands for freight train services in the corridor. This was defined according to the given traffic forecast. Furthermore, the wagon turn-round can gradually be reduced from the present level to 8 - 9 days in 1998, to 6 - 7 days in 2000 and to 5 - 6 days following 2010. This is dependent on speed restrictions being cancelled on the lines. The calculation is based on a factor of maximum use of the wagons load capacity stated by the AGZD authorities. Furthermore, the calculation for the total required stock includes a factor of 20% to cover operational and technical reserves. Thus, the total wagon requirements calculated in an optimistic and a pessimistic variant are shown in the following figures.

Table 3.2.1-16: Future needed wagon stock for the corridor in figures

year	1996	1998	2000	2010	2015
total -opt-	29,118	5,866	7,392	9,106	10,614
total -pess-	29,118	5,396	4,716	5,931	6,698

Following the figures obtained the requirement of the wagon stock will increase in optimistic case from approximate 5,900 (1998) to 10,600 (2015) nevertheless, in pessimistic case from 5,400 (1998) to 6,700 (2015). This development is clearly presented in the following graphic.

Fig. 3.2.1-2: Wagon stock development concerning the corridor



The development concerning the different wagon types and years is shown in Annex 3.2.2-13. The Annexes 3.2.2-14, 3.2.2-15, 3.2.2-16 and 3.2.2-17 reflect the calculation of wagon stock development for the different prospection horizons in details.

A comparison of the existing rolling stock with the future demand for rolling stock shows the necessity to rent or procure as given in Annex 3.2.1-18. According to the figures there obtained it can be seen that the number of tank wagons will be only increased quickly. But the raising demand of tanks with approximate 4,100 (1998) to 7,522 (2015) in optimistic case can be covered by shortening the backlog of maintenance with 1,357 cars in 1998. In 2000 a procurement program of tanks has to be started with 62 tanks followed by 1,531 tanks in 2010 and further 981 tanks in 2015. In pessimistic case the demand of tanks raising from 3,929 (1998) to 4,470 (2015) can be covered by repairing the presently non-operational tank stock.

The increasing demand for covered, platforms and refrigerated wagons generally could be covered by repairing the out-of-order wagon stock. The whole overview concerning procurement and needed main overhauls in order to cover the future wagon demand is given in the following table.

Table 3.2.1-17: Procurement and needed main overhauls for the corridor's wagon stock

		tanks	covered wagons	platforms	refriges	Totals
1998	**m-o-opt**	1,357	0	0	0	**1,357**
-1999	each year	679	0	0	0	
	yearly total				**679**	
	m-o-pess	1,158	0	0	0	**1,158**
	each year	579	0	0	0	
	yearly total				**579**	
2000	**procure-o**	62				**62**
2000	**m-o-opt**	882	65	494	204	**1,645**
-2001	each year	441	33	247	102	
	yearly total				**823**	
	m-o-pess	0	65	494	126	**685**
	each year	0	33	247	63	
	yearly total				**343**	
2010	**procure-o**	1,531				**1,531**
2010	**m-o-opt**	0	65	0	0	**65**
-2011	each year	0	33	0	0	
	yearly total				**33**	
	m-o-pess	107	0	0	0	**107**
	each year	54	0	0	0	
	yearly total				**54**	
2015	**procure-o**	981				**981**
2015	**m-o-opt**	0	129	0	182	**311**
	yearly total				**311**	
	m-o-pess	434	0	0	0	**434**
	yearly total				**434**	

The costs for wagon procurement are estimated with US$ 40,000 per tank wagon and therefore, a financial demand of US$ mill. 2.48 will be needed in 2000, of US$ mill. 61.24 in 2010 and of US$ mill. 39.24 in 2015.

To cover the further increase in the demand of tank wagons in the optimistic case, in the future AGZD should increase the private tank wagon stock in order to decrease the costs. This policy to cover the future increasing demand by extending the private number of tank wagons depends on the policy of the Azerbaijan Council of Ministry (ACM) concerning oil companies. This seems to be more a legal question than a technical one. Therefore, AGZD should demand to be informed by the ACM about the development regarding legal preconditions for extending the private stock.

The future maintenance capabilities for wagons

In order to organise a normal maintenance system for the wagons the respective capabilities are to be developed as follows:

- To re-establish the regular repair capacities (KR of tank wagons) as a short term measure
- To upgrade all existing repair capacities for occasional repair (TR) as a short term measure and depot repair (DR) as a middle term measure
- To cover spare part requirements as a short term measure and inside the yearly planned wagon maintenance as a regular measure.

The **Baku Wagon Repair shop (BWRS)** which carries out the KR of tank wagons should mainly be upgraded by re-establishing the main assembly hall, creating a new paint shop, reconstructing the wheelset division and the roller-bearing section; all accompanied by respective procurement of new equipment for riveting, colouring, wheelset reconditioning and roller-bearing control. The total capital required to modernise the repair shop is estimated as being US$ 16 million. As an urgent measure the delivery of an inductive heated stove for rivets with costs of US$ 14,000 and a capital repair of the wheelset lathe with US$ 90,000 is recommended. These costs were included in the overall costs overview as given in Annex 3.2.1-19.

A more detailed explanation should be given within the framework of the TRACECA project TNREG 9309 "TRACECA -Railways: Rolling Stock Maintenance".

The **Baladshary Wagon Depot** urgently needs to purchase a new bridge crane with a width of 15,650 mm and a load of 5 tons at a price of approximately US$ 50,000. The upgrading of the depots along the corridor as well as the refrigerator depot Aliat (total: 5 depots) as a middle term measure (first phase) will approximately cost total US$ 2.5 million.

The financial requirements for 1998 in order to procure spare parts amount to approximately US$ 2.5 million.

The cost for future annual wagon stock maintenance is estimated as being approximately US$ 500 as a middle for each car per year. Following this estimation the respective total yearly cost will grow up in optimistic case from US$ 2.932 million (1998) to US$ 5.308 million (2015). For the pessimistic case the respective costs are raising from US$ 2.698 million to US$ 3.350 million. The complete overview is given in the following table.

Table 3.2.1-18: Yearly costs of wagon stock maintenance for the corridor

horizons	1998	2000	2010	2015
costs in optimistic case / US$ mill.	2.932	3.700	4.555	5.308
costs in pessimistic case / US$ mill.	2.698	2.359	2.967	3.350

Following the estimation above made concerning the needed reduction of the main overhaul's backlog of wagon stock the respective costs were calculated based on a middle price of US$ 500 in 1998 and 1999[14]. Beginning from 2000 the price is estimated as being approximately US$ 1,000 as a middle for each car.

[14] For these 2 years the procurement of spare parts was separate calculated before as to find under the sections above.

Table 3.2.1-19: Costs of wagon stock main overhauls for the corridor

horizons	1998	1999	2000	2001	2010	2011	2015
costs in optimistic case in US$ mill.	0.340	0.340	0.823	0.823	0.033	0.033	0.311
costs in pessimistic case in US$ mill.	0.290	0.290	0.343	0.343	0.054	0.054	0.434

3.2.1.4 Definition of training requirements

The training requirements for the rolling stock leading personnel of AGZD originate from the changing demands of the AGZD traffic policy, which has to meet requirements of the clients regarding quality and punctuality of freight delivery as well as changing goods structures in the near future. A training course for the middle management of the freight services (10 persons, 1 week) on marketing and further activities should take place. The costs are estimated to be approximately US$ 30,000.

The basic training required for the upper and middle management should emphasise the quality of operational inspections and daily repair work with all types of locomotives and wagons in depots and repair shops. A training course for the middle management of the rolling stock maintenance service (10 persons, 1 week) covering the following issues should take place:

- the quality of all repair works and
- organisation of spare parts stock storage / spare parts management

The costs are estimated as being approximately US$ 30,000.

3.2.1.5 Summary of financial requirements for rolling stock concerning the corridor

All necessary activities and the costs belonging to them are summarised in Annex 3.2.1-19. In case of optimistic development of the traffic on the corridor the financial demand will reach US$ mill. 508.881. But in pessimistic case, US$ mill. 166.654 will be sufficient.

The respective annual rates are as follows:

Table 3.2.1-20: Yearly needed financial volume

year	costs in million US$ in optimistic case	costs in million US$ in pessimistic case
1998	11.087	10.804
1999	11.836	11.555
2000	16.233	8.665
2001	14.153	8.664
2002	10.430	8.321
2003	5.779	3.671
2004	5.779	3.673
2005	5.776	3.516
2006	5.776	31.511
2007	5.776	3.511
2008	5.776	3.511
2009	5.776	3.511
2010	91.107	44.190
2011	33.868	4.190
2012	53.836	4.136
2013	61.835	4.136
2014	61.833	4.136
2015	102.226	4.563
TOTAL	**508.881**	**166.654**

List of abbreviations

AGZD	Azerbaijan State Railway
BWRS	Baku Wagon Repair Shop
BWWSS	Baku wagon washing and steaming station
CIS	Commonwealth of Independent States
CP-3	type of EMU
DC	Direct connection
DR	Middle repair (overhaul)
EMU	Electric Multiple Unit
GDR	German Democratic Republic
GRZD	Georgian Railway
h	hour (s)
KR	main repair, general (capital) repair(s) (overhauls)
kV	kilo Volt
kW	kilo Watt
MIKST	coach with compartments with only a half of weak seats
opt	optimistic
OR	Occasionally repair
pess	pessimistic
RIC	Western European Agreement concerning passenger traffic cars
SW	sleeping car
TECF	Tbilisi Electro-Locomotive Construction Factory
TEWRS	Tbilisi Electro-wagon Repair Plant
TO	technical observation
TR	technical revision
TshD	Locomotive depot
VL-8	Locomotive type
VL-10	Locomotive type
VL-11	Locomotive type
VTshD	Wagon depot
ZMB	luggage car
ZMK	coach with compartments
ZMKR	coach with compartments and radio
ZMO	coach with middle corridor
ZMR	restaurant car

Annexes

Annex 3.2.1-1	Survey of AGZD electric locomotives
Annex 3.2.1-2	Age structure of the AGZD electric locomotives
Annex 3.2.1-3	Brief technical description of the most important electric locomotives
Annex 3.2.1-4	Inventory of freight wagon stock of AGZD
Annex 3.2.1-5	Present number of wagons repaired by AGZD
Annex 3.2.1-6	Occurred damages on AGZD electric locomotives
Annex 3.2.1-7	Comparison of the inventory freight wagon stock with the average damaged stock of AGZD
Annex 3.2.1-8	Volume of maintenance work for the freight wagon stock of AGZD
Annex 3.2.1-9	Development of the daily volume of freight train service on the Trans-Caucasian Corridor -westbound traffic-
Annex 3.2.1-10	Development of the daily volume of freight train service on the Trans-Caucasian Corridor -eastbound traffic-
Annex 3.2.1-11	Demand for main components and spare parts for repair of AGZD locomotives
Annex 3.2.1-12	List of urgently required spare parts for AGZD locomotive repair
Annex 3.2.1-13	Future wagon stock requirements of AGZD 1998 - 2015
Annex 3.2.1-14	Required wagon stock of AGZD in total in 1998
Annex 3.2.1-15	Required wagon stock of AGZD in total in 2000
Annex 3.2.1-16	Required wagon stock of AGZD in total in 2010
Annex 3.2.1-17	Required wagon stock of AGZD in total in 2015
Annex 3.2.1-18	AGZD - Freight wagon stock available and future demand
Annex 3.2.1-19	Finance needs of AGZD in total

Final Report Module A

Chapter 3 Technical Pre-feasibility

3.2 Rolling stock
3.2.2 Georgia

3.2.2 Rolling stock of Georgian Railways

3.2.2.1 Existing situation

3.2.2.1.1 The locomotive fleet of GRZD

A list of abbreviations used in this chapter can be found at the end of this section.
The locomotive inventory of GRZD shows a total of 230.5 electric engines[1]. It is divided into 85 VL-8 (36.9%), 103 VL-10 (44.7%) and 42.5 VL-11 (18.4%). The different types of locomotives and their location in the locomotive shops (depots) are shown in Annex 3.2.2-1. The age structure of the electric locomotives given in Annex 3.2.2-2 shows that all VL-8 are more than 29 years old, whereas the VL-10 are from 22 to 29 years old, the VL-10^{y} 13 to 15 years and the VL-11 6 to 16 years old. The design of all types is characterised by both outmoded controlling system solutions and the lack of modern components and elements. Annex 3.2.2-3 contains a brief technical description of the electric locomotives VL-8, VL-10 and VL-11. All these loco types are double-section units.
Due to both the delay of spare parts and the lack of money to pay for main repair only 76 locomotives (33%) are actually in operation, 154.5 locomotives are out of order. From all 83.5 electrical locomotives type VL-10 and VL-11 in operation as well as waiting for repair, 68.5 locomotives (82%) should be subject to main repair (KR-1, KR-2) to comply with the rules for servicing times of locomotives. 32 VL-8 which are older than 34 years should be scrapped. The question of replacement can only be investigated later within the context for the future locomotive requirements.

3.2.2.1.2 Workshops for locomotives

The maintenance system of GRZD for locomotives includes inspections (TO-1, TO-2, TO-3), overhauls (TR-1, TR-2, TR-3) and main repairs (KR-1, KR-2). The periods of these repairs depend on the running kilometres.
The different maintenance types are shown in the following table:

Table 3.2.2-1: Locomotive maintenance types

abbr.	running kilometres	(approximate time in operation)	type
TO-1			daily service
TO-2			weekly inspection
TO-3	11,000 km	monthly	monthly inspection
TR-1	22,000 km	after 2 months	first overhaul
TR-2	150,000 km	after 1.5 year	second overhaul
TR-3	300,000 km	after 3 years	overhaul with lifting
KR-1	600,000 km	after 6 years	first main repair
KR-2	1,200,000 km	after 12 years	general repair

Only 3 out of the 6 locomotive depots (in total) of GRZD perform services for the Baku - Poti Corridor: **TshD Tbilisi-Sortir.** (62 locomotives), **TshD Khashuri** (65.5

[1] Each locomotive has 2 sections. Therefore, one section will be counted as 0.5 locomotive.

locomotives) and **TshD Samtredia** (54 locomotives). Furthermore, there are two large locomotive factories in Tbilisi:

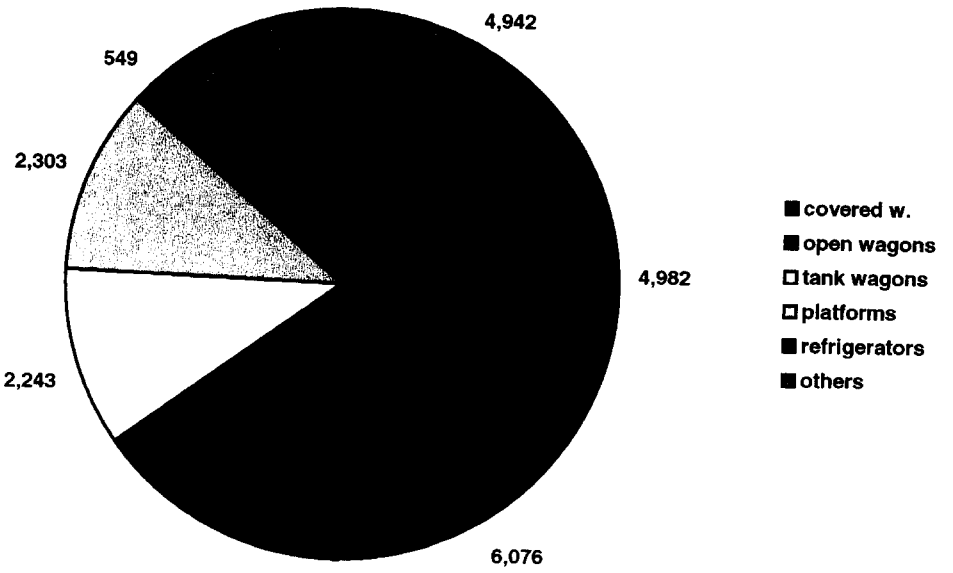
TEVRS - the Electric-Wagon-Repair Factory of Tbilisi and
TESS - the Electric-Locomotive Construction Factory of Tbilisi.

Due to the fact that equipment such as heavy cranes or lifting installations required to carry out the "overhaul with lifting" (TR-3) is limited, in June 1996 the backlog in locomotive maintenance could be stated with 34 locomotives waiting for TR-3 and 69.5 locomotives for KR-1 and KR-2 (68.5 VL-10 and VL-11 + 1 VL-8) as shown in Annex 3.2.2-1.

3.2.2.1.3 Wagon stock

The GRZD wagon inventory shows a total of 21,095 wagons. The distribution of the different types is shown in the graphic below. The wagon fleet is characterised by 4-axle wagons (with 2-axle bogies) with approx. 22 tons tare weight and 65 to 70 tons load capacity. Additionally, a small number of 8-axle (tank) wagons exists (44 tons tare weight, 105 tons load). All wagons are equipped with centre-buffer coupler.

Fig. 3.2.2-1: Wagon inventory stock



The detailed inventory figures are shown in Annex 3.2.2-4.
GRZD has no records available regarding the age structure of the wagons due to the former centralisation of data for the complete freight wagon stock in Moscow. Within the framework of a KfW-study in 1995[2], a survey was carried out to ascertain the actual technical condition of the wagons. The results can be summarised as follows:

- The age of the wagons is rather high, i.e. more than 20 years, except covered and some special wagon types for bulk goods and containers.
- A large quantity of wooden material is still used for doors, walls, floors and roofs.
- A small number of bogies is still equipped with sliding bearings for axle-boxes.

[2] KfW - Kreditanstalt für Wiederaufbau, Frankfurt am Main, "Support for Georgian Railway's Operations for Humanitarian Aid Shipments"

3.2.2.1.4 Workshops for wagons

The GRZD maintenance system for wagons includes inspections (TO, OR, TR) and repairs (DR, KR). For special wagons with unloading or other special equipment the periodic inspection (TR) is divided further into TR-1 and TR-2. The TR-2, DR and KR maintenance services are carried out in periodical intervals.
The maintenance types are shown in the table below.

Table 3.2.2-2: Wagon maintenance types

abbr.	type
TO	daily inspection in trains
OR	daily inspection and accidental repair outcoupled from trains
TR, TR-1	heavy damages, repair in depots
TR-2	after 3 months, regular inspection
DR	yearly repair after one or two years, in depots
KR	main repair after 10 or 12 years, in workshops

Only 3 out of the 4 wagon repair workshops (depots) of GRZD perform services for the Baku - Poti - Corridor: **VTshD Samtredia**, **VTshD Khashuri**, and **VTshD Tbilisi**. In May 1996, repairs comprised of 401 wagons for annual repair (DR), 481 wagons for occasional repair (TR). Details of wagons repaired are shown in Annex 3.2.2-5.

Before the general political changes, the KR maintenance of all other wagon types was carried out by the different specialised wagon repair factories in the different republics of the former Soviet Union. As during the last 5 years no KR was carried out for the wagon stock, i.e. 21,095 units, the theoretic backlog of KR now is to be estimated with about 10,548 wagons.
Given that at present the GRZD has far too many wagons, the question can be posed whether in practice the maintenance further should be time-dependent. As the wagon stock of GRZD meets the requirements of international traffic within the CIS countries even in the future, the question of changing the maintenance rules depends on respective agreements between all the Railway administrations concerned. Concerning the technical point of view, the roller bearings and the brake installation as valves, and cut-off cocks and in case of special wagons as tanks all discharging gates not used for a longer period, are sensitive details of wagons.
Moreover, these sensitive details lose their technical availability dependent on time in the case of not using them.

3.2.2.2 Bottlenecks of GRZD rolling stock

3.2.2.2.1 Locomotive bottlenecks

The problems that GRZD always encounters concerning its locomotive stock for daily train formation, train performances and locomotive maintenance can be seen in the statistics for damaged locomotives as well as in the list of equipment needed for the locomotive shops. These problems are not so apparent due to the actual low level of transport volume.

Locomotive fleet transport capacity

The overall GRZD fleet has 230.5 locomotives of different types. In June 1996, the number of damaged locomotives reached an average of 154.5 per day, i.e. 67%. Each type of locomotive is affected differently by damages, these components are shown in Annex 3.2.2-6. As a result of these facts, it can be estimated that approximately 76 locomotives (33%) are available for operations.
Details of the available locomotives are shown in the table below.

Table 3.2.2-3: Locomotives under operating

type of locomotive	operating in %	number of locomotives
VL-8	59	37
VL-10	81	24
VL-11	100	15

Taking into consideration the distribution of the different types of locomotives to certain depots on the line from the Azerbaijan border to Poti the possible number of trains per day can be estimated as follows.

Table 3.2.2-4: Available trains per day

depot	operating number of locomotives	locomotive turn-back to the depot	daily available trains
Tbilisi	20	1.2	17
Khashuri	14	1.2	12
Samtredia	15	1.2	13

According to the used train operating system, the train is handed over from one depot region to the next one like a relay. The effect of this method is that each locomotive has a fixed crew (engine drivers and assistants). Thus, the possible daily train capacity on the corridor is at present limited to 12 trains per day in one direction. If the speed restrictions could be cancelled by 2000 the turn-back of the locomotives to the depots would be reduced to 0.7 days. In this case the possible daily train capacity would be limited to 20 trains in one direction.

Locomotive stock maintenance

The general maintenance situation of locomotives is based on the old fashioned construction and age of the VL-8 type and VL-10 type. As already shown above there are 230.5 locomotives. The different maintenance measures for TO-1 to TR-3 are carried out in locomotive depots owned by GRZD. For maintenance steps KR-1 and KR-2 GRZD uses the workshops in Tbilisi.

In connection with both the delay of spare parts and the lack of equipment in the depots as a result of the civil war in Georgia, only 76 locomotives (33%) are in operation while 154.5 locomotives are out of order.

15 out of a total number of 85 electric locomotives of type VL-8 and 16 out of 103 VL-10 should be overhauled with lifting (TR-3) to comply with the rules for running kilometres of locomotives.

In order to make up for the backlog in maintaining the locomotive fleet the following repairs should be carried out.

Table 3.2.2-5: Locomotive backlog repair volume

locomotive type	TR-3	KR-1/KR-2
VL - 8	15	1
VL-10	16	1
VL-11	3	66.5

Due to the frequency of the TR-3 of approximately 3 years, one of the urgent questions is how to develop the capacities for TR-3 inside the depots to increase the level of technical reliability.

As 24 VL-8 type locomotives are to be scrapped due to their service life (34 years and older), it is therefore not necessary to carry out the KR-2 for this type (1 locomotive).

Some figures regarding the present situation of technical reliability with respect to the locomotive fleet (see Annex 3.2.2-6) show that in 408 cases locomotives broke down during operation in the first half of 1996. The main reason were faults in the electrical equipment in 112 cases (27%), followed by faults in mechanical components in 106 cases (26%). A special problem is the high wear of the wheelset flange due to operation on winding lines under mountainous conditions.

3.2.2.2.2 Wagon stock bottlenecks

The problems that GRZD always encounters concerning their wagon fleet during daily train operations and maintenance can be seen in the statistics on damaged wagons, in the list of equipment required for the wagon shops, and in the list of spare parts required.

Wagon stock transport capacity

As a result of the new agreement between all railways of the FSU, the existing wagon stock on blocked railways now belongs to these railway organisations. The overall GRZD fleet has 21,095 wagons of different types.

In June 1996, the number of wagons damaged per day reached an average of 16,449 wagons (i.e. approximately 77%). For each wagon type there are different

kinds of damages (see Annex 3.2.2-7). Although the level of damaged freight stock is generally high, for several types it is very high, for example the covered wagon stock with an average of 88% and platform wagons with 86% being damaged per day. As a result of these facts the freight wagon fleet in operation can be estimated as being 4,646 wagons (23%). Details of the fleet in operation are shown in the table below.

Table 3.2.2-6: Operating wagon stock

type of wagon	in operation in %	number of wagons
covered wagons	12.4	610
platforms	13.8	319
open (coal) wagons	18.2	1,108
tank wagons	46	1,032
refrigerators	19.1	105
other wagons	19.3	366
container wagons	19.8	87
cement wagons	13	125
grain wagons	53.9	912

In order to estimate the number of wagons available per day it is necessary to consider the percentage of wagons not available due to technical reasons, such as repairs (DR and KR). Normally this factor can be estimated as being 10%. Investigations made by GRZD have also confirmed this factor to be 10%. In order to estimate the actual possible daily freight volume that can be loaded, the wagon turn-round should be taken into consideration and calculated according to the total time the wagon needs to turn round from the beginning of one loading procedure to the beginning of the next one. This figure depends on the different specifications of the given railway system and is different for each type of wagon. Usually, these figures can be obtained from the railway administration concerned. For the different types of freight wagons the actual possible daily freight volume to be loaded can be divided as follows.

Table 3.2.2-8: Possible daily freight volume

type of wagon	number of wagons	wagons turn-round	daily available wagons to be loaded	load of wagon in tons	daily possible load in tons [3]
covered	549	30	18	42	756
platforms	287	14.5	20	50	1,000
open (coal)	997	22	45	56	2,520
tank	929	9.6	97	62	6,014
refrigerators	95	11	8	28	224
container	78	14.5	5	60	300
cement	113	16	7	63	441
grain	821	8	103	60	6,180

The actual total daily loading capacity using the available stock can only reach a level of about 17,435 tons because only 3,869 wagons are available[4].

[3] The estimation was carried out by using a loading factor depending on the different wagon types.

As a result of the overall wagon availability 140 trains could be operated per day including approximately 10 trains for daily possible new loading, every train consisting of approximately 30 wagons and a load capacity of approx. 1,744 tons. If the number of wagons is limited to 22 per train the daily number of trains would increase to 190 including 14 trains for the daily possible new loading, each train with a load of approx. 1,246 tons.
This relatively low level of new daily loading capacity is based on the wagons available and reflects the long wagon turn-rounds in the first 7 months of 1996 as given by GRZD. In this context it is important to mention that the main reason for the long turn-round is the low train speed due to the speed restrictions on all sections of the main line.

Wagon stock maintenance

The question can be posed about the usefulness of a discussion concerning wagon stock maintenance because the operational stock is presumably far larger than the presently needed stock. The aim here is to show the difference between the volume of a regular wagon maintenance and the maintenance volume for the stock at present only needed in order to work out available weaknesses.
As shown in the previous pages the GRZD wagon fleet contains 21,095 units. In order to maintain this fleet it is necessary to carry out 8,594 middle repairs (DR) and 1,815 main repairs (KR)[5] per year. The division of the wagons into these different types is shown in Annex 3.2.2-8. For the actual operating number of wagons there will be an annual requirement of 1,815 wagons for DR and 403 wagons for KR. Comparing these figures with the actual performed repairs, it is possible to use the following matrix to show the present maintenance situation.

Table 3.2.2-8: Possible monthly wagon maintenance

kind of maintenance	DR	KR
maintenance carried out in May 1996	401	0
actual monthly demand needed for the operating stock	157	34
estimation of capacity	sufficient	not sufficient
monthly demand needed for the inventory stock	716	151
estimation of capacity	not sufficient	not sufficient

The first main problem is the shortage of the capacities to carry out all types of main repairs (KR), which are important for the maintenance system of all wagon types.
The second problem is the occasional urgent repair for the 16,449 damaged wagons located on sidings along the main line. These questions are analysed below together with the forecast for the future requirements.

[4] This estimation does not consider 366 so called "other" wagon types not mentioned in the table above as under this term reference is made to a collection of types with quite different parameters.

[5] The so called "other" wagon types as mentioned above are not considered here.

3.2.2.3 Definition of the volume of repair works

3.2.2.3.1 Repair works of the locomotive stock

In order to deal with the problems which the locomotive service encountered during the last few years, it will be necessary to define the number of locomotives required, followed by an investigation to determine how maintenance capabilities can be developed.

Future locomotive requirements

The number of locomotives required depends on the future train service demands on the corridor's main line which was defined on the basis of the traffic forecast optimistic and pessimistic scenarios. Figures for the train load are stated above. The figures for the freight wagon requirements per day as basis for the forwarding train calculation were obtained from Annexes 3.2.2-14 to 3.2.2-17. In this context it was presumed that the infrastructural improvements will steadily decrease the speed restrictions, which will result in even shorter and shorter wagon turn-rounds as can be seen in the annexes mentioned above.

The freight traffic on the corridor's main line is part of the total operations. Furthermore, it was taken into consideration that the locomotive's return to the depots is shortened from at present 1.4 days to 0.9 days in the year 2010. The results for both directions of the corridor East-West and West-East implies that the demand for locomotives on the corridor will be increased from 27 to 135 in the optimistic case, but in pessimistic case from 24 to 86, based one the fact that the westbound traffic is the dominating one. An overview is to be found under the following table.

Table 3.2.2-9: Locomotive demand for freight train services on the corridor

number of locomotives / horizons		1998	2000	2010	2015
for westbound traffic	optimistic	27	96	122	135
	pessimistic	24	45	62	86
for eastbound traffic	optimistic	29	36	43	50
	pessimistic	25	30	35	41

A complete summary with a split into the different corridor's section concerned is given in Annexes 3.2.2-9 and 3.2.2-10.

Now the demand for operating passenger trains was taken into consideration and therefore, the respective locomotive demand was estimated. The result was a demand of locomotives for passenger train service increasing from 4 in 1998 to 14 in 2015. The respective development is shown in the following table.

Table 3.2.2-10: Locomotive demand for passenger train services

horizons	1998	2000	2005	2010	2015
locomotive demand	4	5	8	12	14

Combining the two demands the required operating loco stock for the corridor main line will grow in the optimistic case from 31 locomotives in 1998 to 149 in 2015 as

shown in the table below. For the pessimistic forecast the loco requirement will grow from 28 locomotives in 1998 to 100 in 2015.
As shown in the following table, the complete phasing grow of the required operating locomotive demand is developed to the inventory stock demand and then compared with the present available locomotives and with a proposed scrapping programme[6] in order to achieve an overview concerning procurement needed in future.

Table 3.2.1-11: Development of the locomotive stock for the corridor's need

horizons	1998		2000		2005		2010		2015	
	opt	pes	opt	pes	opt	pes	opt	pes	opt	pes
loco demand for trains	31	28	101	50	104	53	134	74	149	100
needed loco inventory[7]	37	34	121	60	125	64	161	89	179	120
loco present stock	230	230	198	198	145	145	145	120	155	110
out of order	154	154	94	122	36	69	6	39	0	0
availability of loco stock	76	76	104	76	109	76	139	81	155	110
need of main overhauls	28	0	5	0	30	5	6	29	0	10
scrapping (1) of loco[8]	32	32	0	0	0	0	0	0	0	0
scrapping (2) of loco[9]	0	0	53	53	0	25	0	10	0	0
procurement of loco (1)[10]	0	0	0	0	0	0	0	0	0	0
procurement of loco (2)[11]	0	0	0	0	0	0	10	0	0	0

In the optimistic case the programme to scrap 32 VL-8 type should be realised by annual rates shown in the table. In 2000 the scrapping of the remaining 53 VL-8 type shall start with the following rates and corresponding costs. In the pessimistic case the scrapping programme should start with the same rates, but after 2005 increased by further 35 locomotives of the VL-10 type as shown below in the following table.

[6] The scrapping programme is based on the present situation of technical condition and the age structure of locos.
[7] The reserve factor used is 1.2.
[8] Here scrapping without replacement by new locos.
[9] Here scrapping combined with procurement of new locos.
[10] for replacement
[11] for extension

Table 3.2.2-12: Locomotive scrapping programme

	optimistic		pessimistic	
year	number	estimated costs	number	estimated costs
1998	16	US$ 4,000	16	US$ 4,000
1999	16	US$ 4,000	16	US$ 4,000
2000	14	US$ 3,500	14	US$ 3,500
2001	14	US$ 3,500	14	US$ 3,500
2002	13	US$ 3,250	13	US$ 3,250
2003	12	US$ 3,000	12	US$ 3,000
2005			5	US$ 1,250
2006			5	US$ 1,250
2007			5	US$ 1,250
2008			5	US$ 1,250
2009			5	US$ 1,250
2010			10	US$ 2,500
cost total		**US$ 21,250**		**US$ 30,000**

The costs of locomotive scrapping will amount to a total of US$ 21,250 in the optimistic case and to US$ 30,000 in the pessimistic case.

The necessity to procure locomotives occurs only in the optimistic case after 2010, but in a rather small volume of 10 locomotives with costs as shown below. In the pessimistic case there is no need for procurement.

Table 3.2.2-13: Locomotive procurement programme for the corridor

year	number in optimistic case	estimated costs[12]
2010	10	US$ 40 million
total cost		US$ 40 million

The future maintenance capabilities for locomotives

As shown above the locomotive maintenance system is based on a general repair after 1,200,000 running km, which means after approximately 12 years in service (GRZD conditions). Therefore, an annual number of 12 locomotives forms the basic figure for the different maintenance levels: 70 TO-3, 63 TR-1, 4 TR-2, 2 TR-3, 1 KR-1 and 1 KR-2. The total number of different maintenance types required should achieve the following annual values:

[12] The price of one 5,000 kW locomotive is estimated with USD mln 4.0.

Table 3.2.2-14: Future needed main overhauls and regular maintenance volume for corridor's locomotives and respective costs

year	type	number	TO-3	TR-1	TR-2	TR-3	KR-1	KR-2	yearly costs in US$ mill.
1998 opt	main overhauls[13]	14					7	7	**2.100**
1999 opt	main overhauls	14					7	7	**2.100**
2000 opt	VL-10 + VL-11	104	607	546	35	17	9	9	2.600
	yearly total								**2.600**
2000	main overhauls	5					3	2	**0.700**
2000 pess	VL-10 + VL-11	76	443	399	25	13	6	6	1.900
	yearly total								**1.900**
2005 opt	VL-10 + VL-11	137	799	719	46	23	11	11	3.425
2005	main overhauls	30					15	15	**4.500**
	yearly total								**3.425**
2005 pess	VL-10 + VL-11	76	443	399	25	13	6	6	1.900
2005	main overhauls	5					3	2	**0.700**
	yearly total								**1.900**
2010 opt	VL-10 + VL-11	167	974	877	56	28	14	14	4.175
	new	10	58	53	3	1	0	0	0.150
	yearly total								**4.325**
2010	main overhauls	6					3	3	**0.900**
2010 pess	VL-10 + VL-11	81	473	425	27	17	7	7	2.025
2010	main overhauls	29					19	10	**3.900**
	yearly total								**2.025**
2015	new	10	58	53	3	1	0	0	0.150
opt	VL-10 + VL-11	173	1.009	908	58	29	14	14	4.325
	yearly total								**4.475**
2015 pess	VL-10 + VL-11	110	642	578	37	18	9	9	2.750
2015	main overhauls	10					5	5	**1.500**
	yearly total								**2.750**

For the optimistic case 10 new locomotives are still to be procured in 2010 and afterwards to be considered in the maintenance scheme as well as to be reckoned with respective costs. Moreover, as shown above GRZD should reckon with yearly locomotive maintenance costs of US$ mill. 2.600 in the period from 2000 to 2004, of 4.500 US$ mill in the period from 2005 to 2009, of 4.325 US$ mill in the period from 2010 to 2014 and of 4.475 US$ mill in 2015. The respective costs of the pessimistic case can be found in the above table, too.

To cover the annual demand of KR-1 and KR-2 GRZD should keep the traditional way of co-operation with the factories in Georgia, namely the **Tbilisi Electro-locomotive Construction Factory.** The main direction of the maintenance policy should be to develop a repair / maintenance division within the **Tbilisi Electro-locomotive Construction Factory.**
This repair division could start operations step by step.
First

- a shop for repairing locomotive wheelsets, with costs of mill. US$ 2.65 and
- a traction motors division, with costs of approximately mill. US$ 5.0

as urgent measures.

[13] Here in the table: main overhauls of the out-of-order locomotive fleet

Secondly a shop for repairing the other important electric components as a middle term measure with estimated costs of about US$ 5 million.
The capabilities for locomotive maintenance systems inside the traditional GRZD depot system should be developed by improvements within short and middle terms.
First of all the **locomotive depot Khashuri** should be upgraded by the purchase of

- new equipment for controlling the wheel lathe
- a flange welding machine

to carry out the repair of locomotive wheelsets.

The following equipment is required for the urgent repair of these important components:

-	new equipment to control the wheel lathe Ksh-1836 for the Khashuri depot	1 piece	US$ 20,000
-	wheelset flange welding machine for the Khashuri depot	1 piece	US$ 100,000
-	wheelset lift	2 pieces	US$ 40,000.

The total amounts to US$ 160,000.

Besides the general problems with maintenance equipment the lack of components and spare parts for locomotives is a main problem in trying to maintain normal operations. The amount of equipment required for the locomotive depots and spare parts is listed in Annex 3.2.2-11. Annex 3.2.2-12 shows the urgently required spare parts, materials and elements. As a result of these figures the urgent financial demand for procuring the required equipment is estimated to be approximately US$ 0.8 million in 1998 and 1999. The finances needed for material, spare parts and elements in order to overcome the locomotive maintenance backlog are estimated to be approximately US$ 2.0 million in 1998 and 1999.

3.2.2.3.2 Repair works of the wagon stock

In order to solve the problems which the wagon service encountered during the last few years it is necessary to define the required number of wagons followed by investigations as to how the maintenance capabilities can be developed.

The future wagon stock requirements

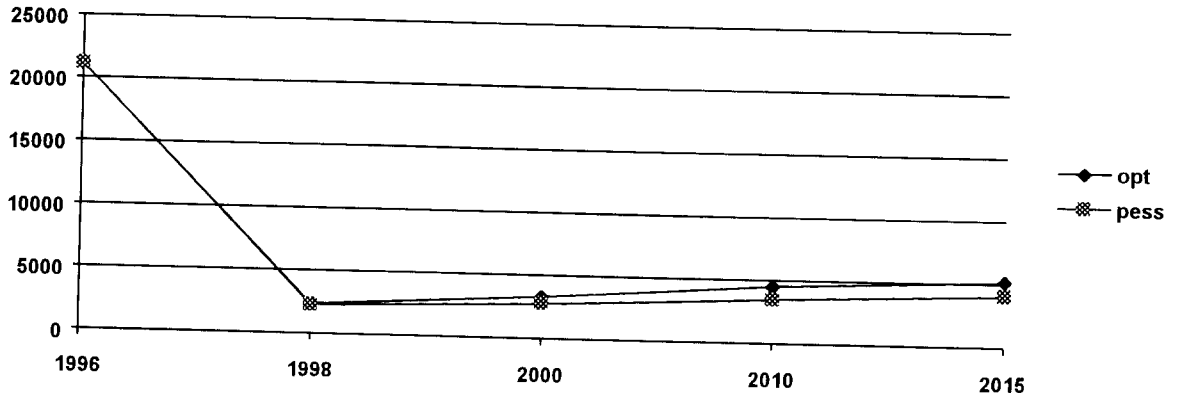
The required number of wagons depends on the future demand for freight train services in the corridor which was defined according to the given traffic forecast. Furthermore, the wagon turn-round can be gradually reduced from the present level to 8 - 9 days in 1997, to 6 - 7 days in 2000 and to 5 - 6 days after 2010 depending on the speed restrictions to be removed on the lines. The calculation is based on a factor of maximum use of the wagons load capacity stated by the GRZD authorities. Furthermore, the calculation for the total required stock includes an additional factor of 20% to cover operational and technical reserves. Thus, the total wagon requirements calculated in an optimistic and a pessimistic variant are shown in the following figures.

Table 3.2.2-15: Future needed wagon stock

year	1996	1998	2000	2010	2015
total -opt-	21,095	2,409	3,361	4,538	5,225
total -pess-	21,095	2,297	2,822	3,528	4,084

Following the figures obtained the requirement of the wagon stock will increase in the optimistic case from approximate 2,410 (1998) to 5,225 (2015), in the pessimistic case from 2,300 (1998) to 4,090 (2015). An overview of this development is presented in the following graphic.

Fig 3.2.2-2: Wagon stock development concerning the corridor



The wagon stock development concerning the different wagon types and years is shown in Annex 3.2.2-13. The Annexes 3.2.2-14, 3.2.2-15, 3.2.2-16 and 3.2.2-17 reflect the calculation of wagon stock development for the different prospecting horizons in details. It should be underlined that this is only a rough estimate due to the nature of the traffic forecast.

A comparison of the existing rolling stock with the future demand for rolling stock shows the necessity to rent or procure equipment as given in Annex 3.2.2-18.

According to the figures obtained, it can be seen that the demand for all types could be covered by reducing the backlog of main overhauls by increasing the repair rate. The respective extent will reach 506 main overhauls (KR) in the optimistic case in 1998, 568 main overhauls in 2000, 1,006 main overhauls in 2010 and another 573 in 2015. The following table gives the complete overview concerning the different wagon types involved as well as the respective pessimistic figures.

Table 3.2.2-16 Needed main overhauls for the corridor's wagon stock

		platforms	open wagons	refriges	other wagons	Totals
1998	**opt**	0	218	40	248	**506**
-1999	each year	0	109	20	124	
	yearly total				**253**	
	pess	0	187	32	234	**453**
	each year	0	94	16	117	
	yearly total				**227**	
2000	**opt**	70	224	70	204	**568**
-2001	each year	35	112	35	102	
	yearly total				**284**	
	pess	0	131	38	126	**295**
	each year	0	66	19	63	
	yearly total				**148**	
2010	**opt**	447	248	94	217	**1,006**
-2011	each year	224	124	47	109	
	yearly total				**503**	
	pess	228	117	46	178	**569**
	each year	114	59	23	89	
	yearly total				**285**	
2015	**opt**	227	141	54	151	**573**
	yearly total				**573**	
	pess	163	113	41	140	**457**
	yearly total				**457**	

On the other hand GRZD, could rent to AGZD more than 50% (appr. 1,500 cars) of the tank fleet.

The future maintenance capabilities for wagons

In order to organise a normal maintenance system for the wagon stock the respective capabilities are to be developed as follows:

- To upgrade all existing repair capacities for occasional repair (TR) and depot repair (DR) as a short term measure
- To cover the needs of spare parts as a short term and a frequent measure
- To establish repair capacities for DR and KR of refrigerators as a middle term measure
- To establish regular repair capacities of KR as a long term measure.
- To cover spare part requirements as a short-term measure and within the yearly planned wagon maintenance as a regular measure.

To prepare the normal work in the existing depots it will be necessary to invest approximately US$ 2.28 million to purchase the urgently required equipment as summarised in Annex 3.2.2-19. The urgent programme should commence with the **Wagon Depot Khashuri** by purchasing four new mechanic lifting jacks with a load of 15 tons at a price of about US$ 60,000.

The amount of needed spare parts is shown in Annex 3.2.2-20. The cost required for 1998 and 1999 is approximately US$ 3.42 million.

The cost for future annual wagon stock maintenance is estimated as being approximately US$ 500 as an average for each car per year. Following this estimation the respective total yearly cost will grow up in the optimistic case from US$ 1.205 million (1998) to US$ 2.613 million (2015). For the pessimistic case the respective costs are raising from US$ 1.148 million to US$ 2.043 million. The complete overview is given in the following table.

Table 3.2.2-17: Yearly costs of wagon stock maintenance for the corridor

horizons	1998	2000	2010	2015
costs in optimistic case / US$ mill.	1.205	1.681	2.269	2.613
costs in pessimistic case / US$ mill.	1.148	1.412	1.764	2.043

Following the estimation above made concerning the needed reduction of the main overhaul's backlog of wagon stock the respective costs were calculated based on a middle price of US$ 500 in 1998 and 1999[14]. Beginning from 2000 the price is estimated as being approximately US$ 1,000 as a middle for each car.

Table 3.2.2-18: Costs of wagon stock main overhauls for the corridor

horizons	1998	1999	2000	2001	2010	2011	2015
costs in optimistic case in US$ mill.	0.127	0.127	0.284	0.248	0.503	0.503	0.573
costs in pessimistic case in US$ mill.	0.114	0.114	0.148	0.148	0.285	0.285	0.457

As a middle term measure the **Tbilisi Electro Wagon Repair Factory** actually carrying out the KR of EMUs should be upgraded to create capacities for maintaining refrigerators by re-establishing the main assembly hall, setting up a new shop for cooling aggregates and another one for diesel engines, reconstructing the wheelset division and roller-bearings shop, reconstructing the bogie division. All the upgrading must be accompanied by the respective procurement of new equipment for colouring, wheelset reconditioning and checking of roller-bearings. The financial investment for developing the repair shop is estimated to be US$ 20 million.

The long term problem of setting up a new wagon repair factory for maintaining the universal freight wagon stock could be solved by using the area in Tbilisi, which was foreseen for a new refrigerator wagon depot. However before creating such a new workshop, investigations should be made to determine the future demand for maintaining the universal freight wagon stock of all Trans-Caucasian railways within the framework of the TRACECA project TNREG 9309 "TRACECA - Railways: Rolling Stock Maintenance".

[14] For these 2 years the procurement of spare parts was separate calculated before as to find under the sections above.

3.2.2.4 Definition of training requirements

The training requirements for the freight service leading personnel of GRZD originate from the changing demands of the GRZD traffic policy which has to meet the requirements of the client regarding quality and punctuality of freight delivery and changing goods structures in the near future.
A training course for the middle management of the freight services (10 persons, 1 week) on marketing and further activities should take place. The costs are estimated to be approximately US$ 30,000.
The basic training required for the middle management of the locomotive and wagon services should emphasise the quality of daily operational inspections and daily repair work with all types of locomotives and wagons in depots and repair shops. A training course (10 persons, 1 week) covering the following questions should take place:
- quality of all repair works and
- organisation of spare parts stock storage / spare parts management

The costs are estimated as being approximately US$ 30,000.

3.2.2.5 Summary of financial requirements

All necessary activities and the costs belonging to them are summarised in Annex 3.2.2-21. In the case of optimistic development of the traffic on the corridor the financial demand will reach US$ mill. 183.517. In the pessimistic case US$ mill. 95.596 will be sufficient. The respective annual rates are as follows:

Table 3.2.1-22: Yearly needed financial volume

year	costs in million US$ in optimistic case	costs in million US$ in pessimistic case
1998	11.667	9.497
1999	10.317	8.147
2000	12.769	10.340
2001	7.069	5.340
2002	6.564	5.001
2003	6.284	4.721
2004	6.281	4.718
2005	11.606	5.265
2006	7.106	4.565
2007	5.106	2.565
2008	5.106	2.565
2009	5.106	2.565
2010	53.997	13.121
2011	7.097	3.218
2012	6.594	2.933
2013	6.594	2.933
2014	6.594	2.933
2015	7.661	5.169
TOTAL	**183.517**	**95.596**

3.2.2.6 Summary of the essential key project "Locomotive repair"

The essential key project „Locomotive repair" under the terms of rolling stock for the "Trans-Caucasian Railways TRACECA project" means the establishment of a repair division in the **Tbilisi- Electro-Locomotive-Construction-Factory** (TECF).

Based on the derived figures for electric line locomotives for train services on the Corridor's main line there exists a respective demand of maintenance as given under Annex 3.2.2-22. Covering this volume of yearly repair, the TECF needs both for KR-1 2 repair places and for KR-2 3 repair places in the optimistic case. For the pessimistic case the respective demand of repair places is of 3 for KR-1 and of 3 for KR-2. The complete overview is to be found under Annex 3.2.2-23.
The establishment of a repair division includes a wheelset repair shop, a traction motor shop and a shop for electric components. Of these three shops the wheelset repair shop with a financial need of 2.65 mill. US$ and the traction motor shop with a financial need of 5.0 mill. US$ should be carried out as first measure in 1998 and 1999. The need of equipment for the wheelset repair shop is to be found under Annex 3.2.2-24.

As a second step, a repair shop for electric components should be founded in 2000 with a finance need of US$ mill. 5.0.

In order to use the given possibilities of halls inside the TECF, the proposal of the consultant insists on using the hall No 3 (corpus 3) for the wheelset repair shop (see Annex 3.2.2-25).
As main repair shop could be used the hall No 1 (corpus 1) (see Annex 3.2.2-26).

List of abbreviations

AGZD	Azerbaijan State Railway
BWRS	Baku Wagon Repair Shop
BWWSS	Baku wagon washing and steaming station
CIS	Commonwealth of Independent States
DC	Direct connection
DR	Middle repair (overhaul)
EMU	Electric Multiple Unit
GDR	German Democratic Republic
GRZD	Georgian Railway
h	hour (s)
KR	main repair, general (capital) repair(s) (overhauls)
kV	kilo Volt
kW	kilo Watt
MIKST	coach with compartments with only a half of weak seats
opt	optimistic
OR	Occasionally repair
pess	pessimistic
RIC	Western European Agreement concerning passenger traffic cars
SW	sleeping car
TECF	Tbilisi Electro-Locomotive Construction Factory
TEWRS	Tbilisi Electro-wagon Repair Plant
TO	technical observation
TR	technical revision
TshD	Locomotive depot
VL-8	Locomotive type
VL-10	Locomotive type
VL-11	Locomotive type
VTshD	Wagon depot
ZMB	luggage car
ZMK	coach with compartments
ZMKR	coach with compartments and radio
ZMO	coach with middle corridor
ZMR	restaurant car

Annexes

Annex 3.2.2-0	List of abbreviations
Annex 3.2.2-1	Survey of GRZD electric locomotives
Annex 3.2.2-2	Age structure of the GRZD electric locomotives
Annex 3.2.2-3	Brief technical description of the most important electric locomotives
Annex 3.2.2-4	Inventory of freight wagon stock of GRZD
Annex 3.2.2-5	Present number of wagons repaired by GRZD
Annex 3.2.2-6	Occurred damages on GRZD electric locomotives
Annex 3.2.2-7	Comparison of the inventory freight wagon stock with the average damaged stock of GRZD per day
Annex 3.2.2-8	Volume of maintenance work for the freight wagon stock of GRZD
Annex 3.2.2-9	Development of the daily volume of freight train service on the Trans-Caucasian Corridor -westbound traffic-
Annex 3.2.2-10	Development of the daily volume of freight train service on the Trans-Caucasian Corridor -eastbound traffic-
Annex 3.2.2-11	demand for main components and spare parts for repair of GRZD locomotives
Annex 3.2.2-12	List of urgently required spare parts for GRZD locomotive repair
Annex 3.2.2-13	Future wagon stock requirements of GRZD 1998 - 2015
Annex 3.2.2-14	Required wagon stock of GRZD in total in 1998
Annex 3.2.2-15	Required wagon stock of GRZD in total in 2000
Annex 3.2.2-16	Required wagon stock of GRZD in total in 2010
Annex 3.2.2-17	Required wagon stock of GRZD in total in 2015
Annex 3.2.2-18	GRZD - Freight wagon stock available and future demand
Annex 3.2.2-19	List of required equipment for wagon repair in GRZD depots
Annex 3.2.2-20	List of urgently required spare parts for GRZD wagon repair
Annex 3.2.2-21	Finance needs of GRZD in total
Annex 3.2.2-22	Total demand of locomotives into the Caucasus region and the respective maintenance in 2005
Annex 3.2.2-23	Needed equipment for a wheelset repair shop
Annex 3.2.2-24	Maintenance places for maintaining electric locomotives
Annex 3.2.2-25	TECF - Bogie and wheelset repair hall
Annex 3.2.2-26	TECF - Locomotive repair hall

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Chapter 3 Technical Pre-feasibility

3.3 Signalling and Telecommunication
3.3.1 Azerbaijan

3.3.1 Signalling and Telecommunication on Azerbaijan State Railways

3.3.1.1 Signalling installations

3.3.1.1.1 Technical data

For operating the stations on the line Baku - Beyuk-Kyassik there are working panel operated signal boxes of Russian construction types BMRZ, BSZ, SZ and MRZ of 1961 - 87. The stations Baladshary and Baladshary-hump have been equipped with new technology of the type BMRZ in 1993-94. Route setting was realised by means of entrance-exit buttons. After running the train the route will be released automatically. In the case of faults or accidents auxiliary releases are possible. On free sections of the line there is an automatic section blocking. Light signals are used for signalling in which duplicate filament lamps are used. Four of the existing stations are still equipped with floodlight signals. There is electric switch drive. There are only six stations where switch drive is hand-operated. Track-release necessary for the automatic blocking is realised over d.c. circuits at 220 V/ 50 Hertz. Power supply for signalling is carried out over an overhead line which is fastened to catenary supports. For a free from interference power supply of the signalling installations a second power supply system on wooden supports outside the track system exists.
The stations situated on the line Baku - Beyuk-Kyassik are shown in Annexes 3.3.1-1 and 3.3.1-2.

Table 3.3.1-1: Selected installations on the line Baku - Beyuk-Kyassik

Installations	Number of installations
Switches	1,475 (124 of them hand-operated)
Light signals	1,393 (36 of them floodlight signals)
Track circuits	752
Interlocking cabins	45
Level crossings	8 automatic installations 11 electrically driven installations 11 mechanical installations

Table 3.3.1-2: Stations with floodlight signals

Station	Number of floodlight signals	Number of switches
Puta	5	12
Atbulak	11	14
Navagi	8	16
Pirsagat	12	15

Table 3.3.1-3: Stations with hand-operated switches

Station	Number of hand-operated switches
Kyrdamir	30
Alabashli	28
Shamkir	21
Dollyar	21
Dsegyam	13
Kovlar	11

3.3.1.1.2 Condition of the existing installations

The technical condition and operability of the installations of the stations and sections are satisfactory. The necessary substitution of worn signal installations has been realised only to a slight extent during the last few years whereas the installations have been always replaced by means available. The increasing age of the technique used will result in a decline in the technical conditions and an increasing number of breakdowns of the installations. The amount of breakdowns with signalling installations in 1995 and 1996 (until April) is shown in Annex 3.3.1-3. However, there is no detailed evaluation of the breakdowns. After the drop in the transport volume the capacity of the sections and stations has been decreased and therefore the breakdowns do not have such consequences. This result even has been positively influenced by the few interlocking operations of switches and signals. The maintenance of the relay installations of the stations is carried out and defective parts are replaced by spare parts if available.

Some of the installations have already reached or passed working life. The following table contains data about some selected installations.

Table 3.3.1-4: Working life of some selected signalling installations

Installations	Period
cables	30 years
light signals	35 years
switch drives	16 years
track circuits	20 years
panel operated signal boxes	25 years
relay stations of the automatic signalling	28 years

Signalling

The outside appearance of the signals and ground signals shows the influence of corrosion on posts and signal hood. Visibility of some signals is restricted for the locomotive crew. This is also caused by the bad condition of the signalling installations mainly used. The repeated signalling in the driver's cab makes it possible for the driver to realise the signal in time and to react to it. The function of the installations is also reduced because of damages by a third party and theft of necessary parts, e.g. relays of the automatic signalling installations or cables of the signal posts of the section blocking and for the power supply of the automatic signalling.

Switch mechanisms

Switch mechanisms of the types SP-6 and SP-3 have been used. The condition and operability of the existing electrical switch drives will be mainly influenced by the bad condition of the switches. The required quiet position of the switch mechanism necessary is not given because of the existing track layout. The outside condition of the switch mechanisms is only satisfactory because of corrosion. The electric motors, point switches and the internal wiring with 60 % of the switch mechanisms have reached the limit of service life.

Track circuits

There are 725 track circuits in the section Baku - Beyuk-Kyassik with a total length of 970 km. The condition of the track installations is the basis for a trouble-free work of the track circuits. Because of the insufficient insulation resistance of the tracks and switches failure rate of the track circuits is rather high. Work of these installations is also influenced by damages or theft of necessary parts, e.g. chokes, connection ropes and connectors. The chokes used and the necessary connection ropes are in a bad condition. Therefore, the workability of the insulation connectors is restricted.
An analysis of the appearing irregularities shows the following percentage share of the various divisions of Azerbaijan State Railways:

60 - 70 %	Track division
15 - 20 %	Signalling
5%	Power supply
5%	others

Cable systems

Cables for supply of outdoor equipment are buried. The cable connecting stands installed in buildings are in good condition. Distribution boards are used for the connection of individual branch cables and the connection of the main cables among each other. The condition of the distributors and lineside boxes is not satisfactory. Failure of the outdoor equipment is influenced by that fact, too.

Level crossings

For the safety at crossings in the section Baku - Beyuk-Kyassik the following installations are :

- 8 automatic barriers
- 11 barriers with electric drive
- 11 mechanical barriers.

At all crossings there is staff. In the case of irregularities or total breakdown the barriers will be operated by hand. Most irregularities at the barriers result from outside influence, e.g. dismantling of signal bells and light signals of road signals. Another main problem regarding the disturbance of the work is the electrically operated motor.

3.3.1.1.3 Necessary measures

With increasing transport volumes the reliability and operability of signalling have to be improved. The renewal of signalling is required in the short and medium term.

The short-term measures relate to the replacing of important parts of existing installations and because of the conditions existing it is more advantageous to apply the available Russian equipment in future, too, which has proved its reliability and robustness. In this case the demands made on the operating and service staff would not change. Studies have shown that the supply with spare parts from Russia is possible at any time provided that the respective financial means are available.

The stations shown in the following table have to be completely replaced by new installations within the next 5 - 10 years.

Table 3.3.1-5: Signalling replacement on stations

station	km	year of construction	number of switches
Kasi-Magomed	417	1961	69
Mugan	405	1967	12
Gadshievo	391	1967	11
Kyrdamir	342	1968	30
Yevlakh	250	1966	53
Geran	225	1969	12
Kyurok-Tshai	214	1966	14
Beyuk-Kyassik	45	1975	47

Furthermore, it is necessary for the increase of the capacity of the section Baku - Beyuk-Kyassik to replace the following signal boxes with hand-operated switches by new panel operated signal boxes. The realisation of this measure is decisively influenced by the volume of freight transport in the section Baku to Georgia. The financial means required are shown in the cost survey in Annex 3.3.1-4.

Table 3.3.1-6: Replacement of hand-operated switches on stations

Station	km	Year of construction	Number of switches
Kyrdamir	342	1968	30
Alabashli	170	1963	30
Shamkir	159	1962	16
Dollyar	149	1962	21
Dsegam	136	1961	13
Kovlyar	122	1961	17

For restoration to the full operability of the signalling system the following short-term measures are required:

Signals

- Replacement of 23 complete light signals
- Replacement of 32 complete ground signals
- Replacement of 1,500 light signal lenses
- Replacement of branch cables for 10 signals
- Replacements of signal lamps for 300 signals
- Replacement of 50 light signal hoods

Furthermore, all signals have to be newly painted.

Switches

- Replacement of the electric motors of approx. 1,000 switch drives
- Replacement of approx. 400 complete switch drives
- Replacement of internal wiring of appr. 300 switch drives
- Replacement of the closing devices of 300 switch drives

Furthermore, all switch drives have to be newly painted.

Track circuits

With the equipment of the track circuits the connectors, connecting ropes and impedance bonds with secondary winding have to be replaced.

- Substitution of 300 impedance bonds with secondary winding of different types
- Substitution of approx. 500 complete unit connection ropes and connectors.

Level crossings

With barriers at the crossings the following parts have to be renewed:

- replacement of 80 gate motors
- light signals for signals
- alarm equipment.

Furthermore, maintenance of the power supply installations of automatic block equipment as renewal of wiring for power supply, substitution of transformer stations and renewal of masts for power supply route are necessary.

Supply of spare parts

Before political changes in the former Soviet Union signalling equipment was produced in other Soviet Republics. This signalling equipment was also supplied to and used in Azerbaijan. Therefore, the provision with spare parts needed and of complete installations for signalling is only possible from Russia. There is no production of spare parts in the field of signalling technics in Azerbaijan. Because of financial problems no spare parts have been bought during the last few years and the parts required for repairs and maintenance have not been supplied. Necessary spare parts could be provided only by refurbishing old material.

3.3.1.2 Telecommunication equipment

3.3.1.2.1 Technical data

On the line Baku - Beyuk-Kyassik there is used a telecommunication system with 60 channels „K-60". Connection is realised via wires and overhead lines. The type of cable is MKPAB-7*4*1, 05+5*2. Connections are carried out automatically or through operators.

3.3.1.2.2 Conditions of the existing equipment

The main problems are the unstable connections in the telecommunication sector. This fact has considerable influence on railway traffic, too.
On the line Baku - Beyuk-Kyassik, section Baku - Aliat, on a length of 67 km there are used air lines. This equipment was built in the beginning of the 1980ies; all other connections are realised via overhead lines which were built in the 30ies. The sleeves needed for the connection of the lines have been used since 1983 and partly have become porous. This condition has influence on the function of the telecommunication equipment. The most important line section is the section Kishli - Baladshary.
A survey of total failures of telecommunication technics in 1995 and 1996 (until April) is included in Annex 3.3.1-5. Furthermore, because of the through electrification of the line the influence on telecommunication technics by electric fields is a problem which has to be considered with the renewal of the telecommunication equipment and the new cable line resulting from it.

Dispatching equipment

The existing equipment have been built in the period from 1970 - 1990. As a result of financial bottlenecks the equipment have not been maintained regularly and the necessary substitution of parts has not been realised.

Teleprinting equipment

The equipment used have been installed in the period from 1965 - 1990. There are the following devices:

Table 3.3.1-7: Number of teleprinting equipment

Type of device	number
T-63	75
STA-CTA-67	39
F-1100 and F-2000	45

Devices T-63 and STA-CTA-67 will not be used any more because of their technical condition. Use of types F-1100 and F-2000 is strongly restricted because of the lack of spare parts.

Radio equipment

Radio-control of trains facilitates the exchange of information between the stations and the trains. Furthermore, the trains which are on the line section can be reached by the service staff of the stations. Accordingly, the stations of the line Baku - Beyuk-Kyassik and the trains are equipped with radio-control equipment. There are also

portable radio telephones for the train formation staff. The available equipment are working, but have a reduced transmission quality.

3.3.1.2.3 Measures required

The aim of the measures to be executed is the improvement of the condition of the equipment in the short term. It is also necessary to put into use new modern equipment to meet the requirements of increasing transport volumes. Another important fact with respect to the realisation of the transport volume and the safety of passenger and freight transport is a stable telecommunication network between all those involved in the transport process. Important equipment as power supply, air-conditioning, information systems as well as watches are included in the further annexes in the cost survey.

Cable systems

The requirements to the transmission lines have to be met by a modern and efficient cable equipment. According to this the use of glass-fibre cables is intended for the section Baku - Beyuk-Kyassik, for the main line there will be used a glass-fibre cable with 147 fibres. This dimension will meet all future requirements to the transmission network so that it will not be necessary to exchange the glass-fibre cable in case of an increase of the demand. To secure the full availability of the system there shall be laid two cables along the line. A survey about the equipment is included in Annex 3.3.1-6.

Communication equipment

The communication system required has

- to cover the high needs to the transmission lines
- to guarantee the permanent availability of the connections

It is intended to use a SDH-system (Synchrone Digital Hierarchy) with 155 Mbits/s. Through the use of Add/Drop-Multiplexer (ADM) with optical STM1-points of intersection it is possible to form a STM1-ring and to make the transmission lines fully available. The ADM also allow to decouple signals between the network junctions from the STM1-ring and to newly seize the vacancies.
The STM1-ring facilitates connections of 1920 channels per fibre of the glass-fibre cable. The Cross Connect Multiplexer (CCM) in Baku facilitates a connection with other networks than those of the railways. Annex 3.3.1-7 shows how the STM1-ring is assembled as well as the use of CCM and ADM. With the use of the STM1-system there will be also sufficient channels for other services and users outside the railways.

Switching equipment

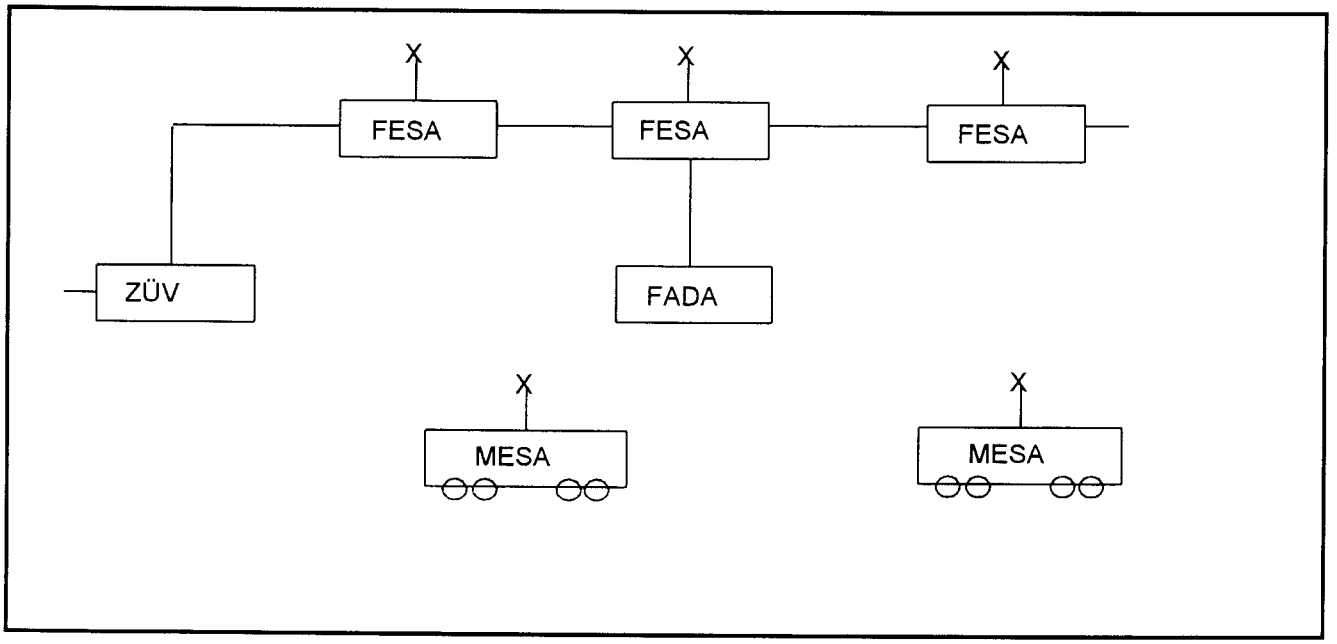
At first maintenance of the available transmission system has to be improved. Furthermore, long-term measures are required. In order to meet the growing requirements of telecommunication the gradual exchange of existing connections by operators and automatic connections with analogue equipment by digital equipment, e.g. quasi-digital switching equipment, is essential. This would allow to connect analogue telephones through analogue concentrators to the digital switching equipment. Building up of a switching centre could be realised in several stages beginning with some subscribers up to 100,000 subscribers.

Radio equipment

Due to the necessary growing requirements to radio transmission between the various stations and the locomotive crew a new installation in the section Baku - Beyuk-Kyassik is needed. It is suggested to use the system „Train Radio 2002" which is a microcomputer-controlled radio system of a modular construction for voice and data in conformity with European Standards.

The system provides for the line permanent lineside radio installations (FESA). They consist of radio stations and directional radio aerials fixed to concrete poles. When connecting operators of stations the traffic controller installations (FADA) are installed. An important part is the ZÜV 2002 (supervision of train running) which includes the installations of the responsible traffic controller and facilitates the transmission of information to the future central control. The tractive units shall be equipped with mobile railway radio installations (MESA). Shunting staff will use portable radio sets.

Plan of the system „Train Radio 2002":



Supply of spare parts

The spare parts needed for short-term measures to improve the maintenance condition of telecommunication equipment have to be procured after provision of financial means. Agreements concerning the supply of spare parts for new installations shall be included in the delivery contract within the framework of the first installation with the corresponding companies.

3.3.1.2.4 Maintenance

Organisation and equipment

There are no central workshops divided into signalling and telecommunication workshops, the existing central workshops form a unit. The central workshops in the various departments are responsible for maintenance and repair of signalling and telecommunication installations. The technical parameters of the parts and installations shall be checked and recorded in the controlling centre (KVP).
Tasks which result from the suppression of the installations are recorded by the dispatcher and coordinated. For the analysis all irregularities have to be recorded and evaluated in the departments. For the exchange of information the maintenance staff and the dispatcher are connected with each other by an internal network.
There are the following central workshops for signalling and telecommunication installations:

- Baku
- Baladshary
- Kasi-Magomed
- Yevlakh
- Gyandsha
- Akstafa

The locations of these workshops are included in Annex 3.3.1-1.
The existing workshops are provided with the equipment needed for repairs, maintenance and inspections according to the required technical parameters.
However, it is necessary to introduce modern measuring instruments and other tools.
The complete rehabilitation and equipment of the central workshops in Baku, Kasi-Magomed, Yevlakh and Gyandsha are essential. In order to carry out a quick and efficient maintenance and suppression it is important to replace the existing maintenance cars.

Staff

In the signalling and telecommunication department there are working 2,317 employees. 30 of them are working in the central workshops. The working groups consist of 2 - 4 employees who are responsible for maintenance and inspection of repaired parts regarding the compliance with mechanical and electrical standards.
For the signalling installations on-site there are responsible 912 employees, for telecommunication installations 663.

3.3.1.2.5 Financial requirements

Signalling equipment

The necessary financial means are indicated as follows:

Table 3.3.1-8: Financial need for signalling installations

year	expenses in mill. US$
- 2000	16.5
2001	27.5
2002	15.8
2003	13.1
2004	16.2
2005	18.6
2006	12.7
2007	8.1
2008	10.1
total	**138.6**

The yearly financial need concerning signalling installations is calculated based on the prices for spares given in the table below.

Table 3.3.1-9: Unit prices of spare parts and signalling installations

no.	item	unit	number	unit price US$
1	light signals, complete	piece	23	14,000
2	dwarf signals, complete	piece	32	5,000
3	light signal lenses	piece	1,500	1,750
4	signal hoods	piece	50	5,000
5	mounting accessories for light signals	lump sum		990,000
6	switch mechanisms, complete	piece	400	7,050
7	mounting accessories for switch mechanisms	lump sum		950,000
8	choke transformers	piece	300	3,500
9	connecting ropes	piece	500	2,400
10	barrier engines	piece	80	1,400
11	axle counters	piece	1,000	6,000

The financial means needed for all measures are shown in detail in Annex 3.3.1-4.

Telecommunication equipment
The necessary financial means are indicated as follows:

Table 3.3.1-10: Financial need for telecommunication equipment

year	expenses in mln. US$
- 2000	12.0
2001	5.6
2002	5.1
2003	4.6
2004	4.0
2005	3.5
2006	2.8
2007	2.8
2008	2.7
total	**43.1**

The financial means needed for all measures are shown in detail in **Annex 3.3.1-8**. The yearly financial need for telecommunication equipment is calculated based on the prices for equipment and spares given in the table below.

Table 3.3.1-11: Unit prices of radio equipment

no.	item	unit	number	unit price US$
1	FESA	piece	27	40,000
2	FADA	piece	48	20,000
3	antennas	piece	27	8,000
4	poles	piece	27	40,000
5	switching buildings	piece	27	20,000
6	equipment of locomotives	piece	150	40,000
7	train dispatcher equipment	piece	10	25,000
8	portable radio equipment	piece	500	1,400

The yearly financial need for cable equipment is calculated based on the prices given in the table below.

Table 3.3.1-12: Unit prices of the cable equipment

glass fibre cable	1,070 km	US$ 15,900/km
equipment	48 stations	US$ 65,000/piece
equipment of the nodes/network management	1 main line	US$ 188,000

List of abbreviations used

ADM	add/drop multiplexer
CCM	cross connect multiplexer
EU	European Union
FESA	stationary railway line radio installations
FADA	train dispatcher facilities (traffic controller installations)
KVP	checking point
LWL	optical fibre cable
MESA	mobile railway line radio installations
STM-1	synchronous transfer mode with a transmission speed of 155 Mbit/s
SDH	synchronous digital hierarchy
V	volt
PCM	pulse code modulation
ZÜV	train dispatcher (supervision of train running)

Annexes

Annex 3.3.1-1	Line section Baku - Beyuk-Kyassik of AGZD
Annex 3.3.1-2	Stations of AGZD section Baku - Beyuk-Kyassik
Annex 3.3.1-3	Number of failures on the AGZD signalling installations
Annex 3.3.1-4	Schedule of costs for signalling equipment and installations for AGZD
Annex 3.3.1-5	Number of failures on the AGZD telecommunication installations
Annex 3.3.1-6	Survey of AGZD lines with telecommunication installations
Annex 3.3.1-7	Survey of AGZD systems of telecommunication installations
Annex 3.3.1-8	Schedule of costs for telecommunication installations for AGZD

Final Report Module A

Chapter 3 Technical Pre-feasibility

3.3 Signalling and Telecommunication
3.3.2 Georgia

3.3.2 Signalling and telecommunication on Georgian Railways

3.3.2.1 Signalling installations

3.3.2.1.1 Technical data

Signal boxes with push-buttons of Russian construction from the period 1960 - 1991 are used for operation on railway stations. The routes are set up by means of start and target keys. After the train ride will be terminated the route will be released automatically. In the event of an accident occurring auxiliary releases are possible. On free line sections an automatic section block is available. Only light signals are used for signalling. The announcement that the track is free is passed on to the automatic block through track circuits. Power supply of the signalling systems on the track is implemented through an overhead line which is fixed at the railway poles. A second power supply line is available for a trouble-free power supply of the signalling equipment. A survey of the stations situated at the Tbilisi-Poti/Batumi line is contained in Annexes 3.3.2-1 and 3.3.2-2.

Table 3.2.2-1: Selected installations at the Tbilisi - Poti/Batumi line

Installations	Installations altogether
Switches	1,397
Light signals	2,044
	(1,100 signals thereof are not operative)
Track circuits	2,682 on the line
	(2,256 thereof are not operative)
	2,226 on the stations
	(1,911 thereof are not operative)
Interlocking cabins	69
Level crossings	30
	2 automatic installations
	4 mechanical installations
	24 installations are not operative

3.3.2.1.2 Condition of the existing installations

The technical condition and the operatability of the systems of railway station and line equipment still existing is satisfactory. A semi-automatic section block exists on the line sections between Gardabani-Tbilisi-Uslovaya and Kaspi-Samtredia, i.e. train traffic is only possible between adjacent stations. An operative automatic section block exists between the Tbilisi-Uslovaya - Kaspi stations. The signalling equipment on the Samtredia - Poti and Samtredia - Batumi sections is no longer operative. Switch mechanisms and choke transformers are to be regarded as the priority of the equipment used. An emergency unit is available on the Gardabani - Zestafoni section to ensure a trouble-free power supply of the signalling equipment. Yet, a problem is the unstable supply of power in the period between November and May. A survey of the line sections is contained in Annex 3.3.2-3.

Signals
As to the outer condition of the signalling and dwarf signalling equipment you can detect corrosion at the poles and signal screens caused by outer influences. The visibility of some signals is limited for the staff of the locomotive. Yet, this is also caused by the bad condition of the signal lenses predominantly used. Functioning of the equipment is affected by damages caused by third persons and theft of required elements, e.g. the relay systems of the block cupboards of the automatic block, the branch cables at the signal poles, and the lines for the power supply of the equipment of the automatic section block.

Switch mechanisms
The condition and the operatability of the existing electric switch mechanisms is predominantly affected by the bad conditions of the switches. The required quiet position of the switch mechanism is not given by the existing track layout. Due to corrosion the condition of the switch mechanisms is only satisfactory. In approx. 70 % of the switch mechanisms the electric motors used, the point switches and the internal wiring reached the limit of their service lives.

Track circuit
In stations there exist 2,226 and on line sections 2,682 track circuits on the Tbilisi-Poti/Batumi line. 1,911 track circuits thereof in stations and 2,256 on line sections are no longer operative due to various elements having been stolen. The basis for a trouble-free functioning of the track circuits is the condition of the tracks. Due to the bad resistance of insulation of the tracks and switches the still existing track circuits break down permanently. The chokes used, the connection ropes and connectors required for connection to the track are in a bad condition.

Cable systems
All cables supplying electric power to outdoor installations are buried. The cable connecting stands installed in buildings are in a good state. Distribution boards are used for the connection of individual branch cables and the connection of the main cables among each other. The condition of the track connecting boxes was not satisfactory.

Level crossings
For safety reasons 30 level crossings exist on the Tbilisi-Poti/Batumi line. Yet, only 2 automatic gate installations are still operative, 4 installations are mechanical gate installations. The safety facilities of the other installations have been dismounted due to vandalism.

3.3.2.1.3 Measures required
To increase the present traffic volume the operatability of the signalling equipment has to be improved and the dismounted facilities have to be replaced. It will be necessary to replace the signalling installations in the short and medium term. Short-term measures relate to replacing of existing installations and to achieving their operatability to increase reliability. After having inspected the existing signalling installations and studied the conditions prevailing here it would seem to be more advantageous to apply Russian equipment also in future. It has proved its reliability and robustness in the last years. Thus, the demands made on the operating and service staff would not change. Studies have always confirmed that in case of

financial funds available a supply of spare parts from Russia will be possible at any time.
Replacing the existing track circuits by wheel counting devices and their adaptation to the existing equipment is envisaged as a medium-term measure. In addition, it will be necessary to undertake further actions such as to restore the automatic section block and to complete the equipment required in this connection to increase the passage of the line.
The Georgian Railways has already charged the existing planning office with preparing the plans for the Samtredia - Poti and the Samtredia - Batumi line sections. That means, that the stations existing in this section shall be put into operation with restricted functions. A semi-automatic block will be installed between the individual stations. No longer existing outdoor installations will be put out of operation or repaired using still available spare parts. The Signal and Telecommunication Equipment Department has already laid a glass fibre cable provided by EU in the Samtredia - Poti and the Samtredia - Batumi sections. Adaptation elements have been developed for the transmission of the required information. For the time being, financial funds are still lacking to implement this measure. The funds required for this are contained in the survey.

The following short-term measures will have to be implemented in the individual before-mentioned parts of the system to reach the full functioning of the signalling system and to replace the dismounted equipment.

Signals

* replacement of 262 complete light signals
* replacement of 1,200 light signal lenses
* replacement of branch cables for 100 signals
* replacement of signal lamps for 500 signals
* In addition, all existing light signals are to be newly painted.

Switches

* replacement of electric motors for 250 switch mechanisms
* replacement of 500 switch switches
* replacement of internal wiring for approx. 980 switch mechanisms
* replacement of locking facilities of 500 switch mechanisms
* replacement of 100 complete switch mechanisms
* In addition, all existing switch mechanisms have to be newly painted.

Track circuits

Connectors, connecting ropes and 400 choke transformers have to be replaced in the facilities of the still existing and operative track circuits. A complete equipment of 1,911 track circuits in stations and 2,226 track circuits on line sections will be required.

Level crossings

The following components have to be replaced in gate installations of level crossings:

* gate motors
* light signal lenses for road signals
* alarm systems.

The signalling equipment of 20 former automatic gate installations which are no longer operative due to various components having been dismounted has to be completely replaced.
Furthermore, power supply facilities of automatic block facilities have to be serviced, i. e. supply mains, transformer stations and poles for the power supply line have to be replaced. A second line has to be installed in the Samtredia - Poti and the Samtredia - Batumi sections for an emergency power supply.

Supply of spare parts
Before the political changes have taken place in the former Soviet Union, all signalling installations had been produced in other Soviet republics. Signalling equipment had also been sent to Georgia and installed there. Due to this history it is possible to get the required spare parts and complete installations for the signalling systems only from Russia. Because of the lack of financial resources spare parts have not been bought in the last few years. Elements required for repair and maintenance were not completed. Spare parts required were taken from waste material.

As of 1997 it is envisaged that the „TEWS" company will produce spare parts for signalling installations in Georgia. It is planned to produce parts of the electric switch machines, signal screens and chokes. To this end, samples of the parts to be produced were handed over to „TEWS". For the time being, it is considered which of the available machines may be used and where the production will have to be changed to meet the new demands. After implementing this measure it will be possible for the „TEWS" company to take over the production of spare parts also for the Azerbaijan State Railways on the basis of contractual arrangements.

3.3.2.2 Telecommunication equipment

3.3.2.2.1 Technical data
A system involving 60 „K-60" channels and a system involving 30 channels will be used on the Tbilisi-Batumi/Poti section for the telecommunication traffic. A system with 12 channels exists between Gardabani and Tbilisi. The communication path will be implemented by cables. Predominantly MKPAB-7*4*1.2+5*0.9+1*0.7 is used as cable type. MAVM-K-7*4*1.2+5*0.9+1*0.7 cables are used on the Batumi-Lantshkhuti-Samtredia sections. Automatic and manual exchanges are used to build up telecommunication.

3.3.2.2.2 Condition of the existing equipment
A priority are the unstable connections of the telephone network. This fact has also a remarkable influence on the train traffic. The whole telecommunication line of the Tbilisi-Batumi/Poti line was cabled. The equipment between Tbilisi - Gardabani was installed in 1984, between Tbilisi - Khashuri in 1982, between Khashuri - Zestafoni in 1979 and between Zestafoni and Samtredia in 1980. The cables required for the connection were dismounted on various sections due to vandalism. This condition had a remarkable influence on the operativeness of the telecommunication facilities. Cables are no longer to be found in the following sections:

Table 3.3.2-2: Sections with missing cables

from	to	km	type	
Senaki	Abasha	13.4	MKPAB-7*4*1.2+5*0.9+1*0.7	
Gardabani	border	9.1	MKPAB-7*4*1.2+5*0.9+1*0.7	
Marneuli	Sadakhlo	29.1	MKPAB-7*4*1.2+5*0.9+1*0.7	
Batumi	Lantshkhuti	73.5	MAVM-K-7*4*1.2+5*0.9+1*0.7	*)
Lantshkhuti	Samtredia	30.5	MAVM-K-7*4*1.2+5*0.9+1*0.7	*)
Senaki	Poti	38.3	MAVM-K-7*4*1.2+5*0.9+1*0.7	*)

*) The Railway has already laid glass fibre cables in these sections.

Radio equipment

Radio service on trains allows the connection between the stations and traction vehicles. In addition, traction vehicles which are on open track sections may be contacted by the operating staff of the stations. The stations of the Tbilisi - Batumi/Poti line and the traction vehicles are equipped with radio-service equipment for trains. Apart from that, portable wireless equipment provided by EU is available.

3.3.2.2.3 Measures required

When envisaging the measures to be undertaken it has been always proceeded on the fact that the condition of the equipment of the Tbilisi-Batumi/Poti line has to be improved in the short term. In addition, it is necessary to use modern equipment to satisfy the demands connected with the transport volume. An important fact in coping with the transport volume and providing safety in the passenger and freight traffic is a stable communication connection between all participants of the transport process. The facilities required such as power supply, air conditioning equipment, communication equipment and clock equipment form part of the cost survey under the item „Miscellaneous facilities".

Cable systems

The demands on communication paths have to be secured by a modern and efficient cable equipment. Following this necessity it is envisaged to use glass fibre cables on the Tbilisi - Batumi/Poti line section. It is envisaged to use two glass fibre cables with 147 fibres on the main line between Tbilisi and Samtredia. On the Samtredia - Batumi/Poti sections the existing glass fibre cables already laid by the Georgian Railways will be used. This cable system will take into account the future demand for communication paths. That means, it will not be necessary to replace the glass fibre cable in the event of rising demand. To ensure the full availability of the cable system on the main line, two cables will be laid along the line. Annex 3.3.2-5 includes a survey of the cable equipment.

Communication equipment

The required communication system has to

- satisfy the high demand for communication channels,
- ensure a constant availability of communication.

An SDH (synchronous digital hierarchy) system with 155 Mbit/s is envisaged. By using add/drop multiplexers (ADM) with optical STM1 interfaces an „STM1 ring" is formed and thus the full availability of the communication channels is given.

The ADM allow to decouple signals between the network junctions from the STM1 ring and to newly seize the vacancies. The chosen STM1 ring allows to make connections over approx. 1,900 channels per fibre of the glass fibre cable. The cross connection multiplexers CCM stationed in Tbilisi allow to establish a connection also to networks outside the railway. Setting up the STM1 ring and using CCM and ADM is represented on the system drawing in Annex 3.3.2-6.

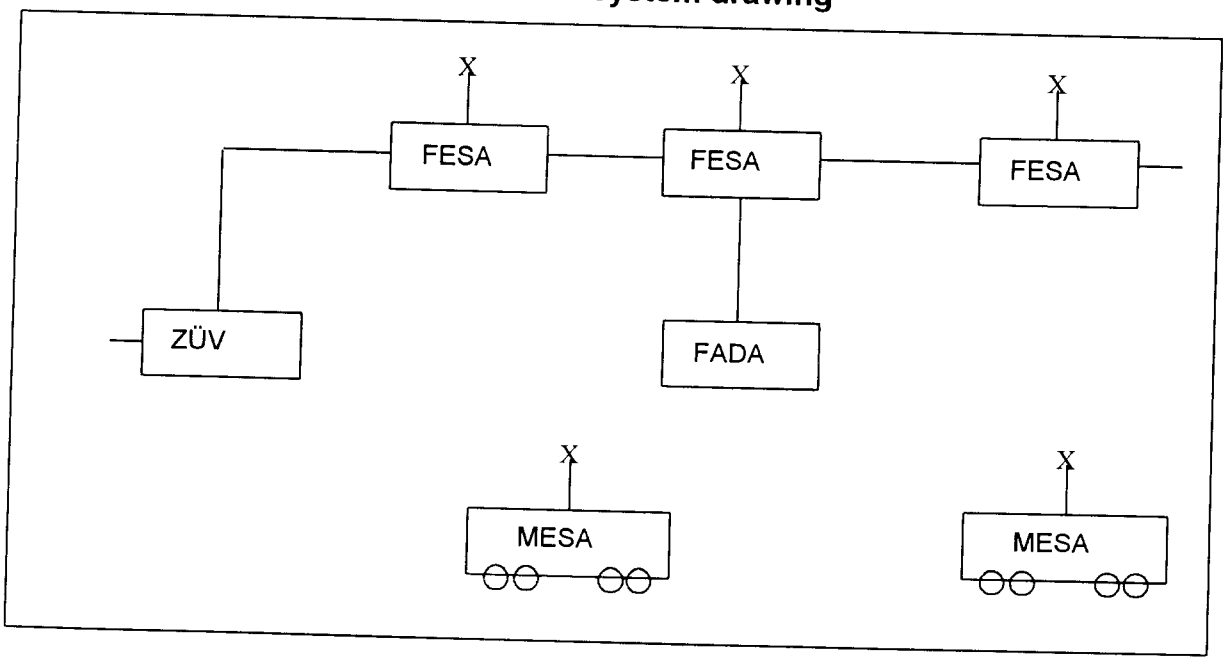
Switching equipment

A first step is to improve the conditions of maintenance of the existing exchanges. In addition, longer-term measures will have to be taken. To satisfy the grown demands for switching services in telephone traffic the existing manual exchanges and automatic exchanges with analogue equipment are to be gradually replaced by digital exchanges. It is recommended to use quasi-digital exchanges. In these switching systems analogue telephone sets may be connected to a digital exchange via analogue concentrators. An exchange may be extended in a few stages, from a small number of subscribers to 100,000 subscribers.

Radio equipment

A new equipment will be required for the Tbilisi-Batumi/Poti line section to satisfy the higher demands for radio communication between the individual stations and the locomotive staff. The train radio-service system 2002 is recommended here. This system is a microcomputer-controlled radio system of a modular construction for voice and data communication in conformity with European standards. This system envisages stationary railway line radio equipment FESA on this line. They consist of radio stations and radio-link antennas installed on concrete poles. If operators of stations have to be connected so-called FADA (station master) equipment has to be installed. An important component is ZÜV 2002 containing the facilities of the traffic controller. They allow to transmit information to a later operations management centre. Traction vehicles will be equipped with mobile railway line radio equipment MESA. Portable wireless equipment will be used for the shunting area.

Fig. 3.3.2-1: Train radio-service 2002 system drawing



Supply of spare parts

After the financial funds will be provided the spare parts required for the implementation of short-term measures to improve the maintenance condition of telecommunication equipment are to be purchased. The supply of spare parts for the new equipment is to be agreed upon with the respective companies in the framework of the original equipment on the basis of supply contracts.

3.3.2.3 Maintenance

3.3.2.3.1 Organisation

Central repair shops specialised separately in signalling equipment and in telecommunication equipment do not exist, the existing central repair shops form a unity. The central repair shops in the individual sectors are responsible for the maintenance and repair of signalling and telecommunication equipment. The technical parameters to be observed for the elements and the equipment used in signalling and telecommunication systems are verified and documented in the central repair shops.

There are the following central repair bases for the equipment of signalling and telecommunication systems:

* Tbilisi
* Samtredia
* Khashuri

The locations of the repair bases are contained in Annex 3.3.2-1.

The existing repair shops are equipped with the appliances required for repair, maintenance and checking whether the technical parameters are observed. Yet, it is necessary to gradually purchase modern measuring instruments and other tools. To carry out a fast and effective maintenance and screening it is imperative to replace the available maintenance cars by new cars and construction equipment (e.g. cranes and elevators, excavators for earth work).

3.3.2.3.2 Staff

1,100 persons are employed in the Signalling and Telecommunication Equipment Department. 148 of them fall to central workshops for signalling and telecommunication equipment. 57 staff members are employed for repair and testing of the necessary relays. 91 staff members are employed for the repair and maintenance of the equipment of the department.

3.3.2.4 Financial requirements

3.3.2.4.1 Signalling installations

The financial funds required are indicated in the following survey:

Table 3.3.2-3: Financial need for signalling installations

Year	Expenses in US$ million
- 2000	23.8
2001	24.5
2002	12.8
2003	10.6
2004	12.2
2005	14.2
2006	8.7
2007	8.6
2008	8.6
total	**124.0**

The calculation of the yearly finance need for signalling installations is based on prices for spares given in the table below.

Table 3.3.2-4: Unit prices of spare parts and signalling equipment

no.	item	unit	number	unit price US$
1	light signals, complete	piece	262	14,000
2	dwarf signals, complete	piece	32	5,000
3	light signal lenses	piece	1,200	1,750
4	signal hoods	piece	50	5,000
5	mounting accessories for light signals	set	1	990,000
6	switch mechanisms, complete	piece	100	7,050
7	mounting accessories for switch mechanisms	set	1	950,000
8	choke transformers	piece	1,000	3,500
9	connecting ropes	piece	1,000	2,400
10	barrier engines	piece	30	1,400
11	axle counters	piece	1,300	6,000

The financial funds required for the implementation of all measures are broken down in greater detail in Annex 3.3.2-7.

3.3.2.4.2 Telecommunication equipment

The financial funds required are indicated in the following survey:

Table 3.3.2-5: Financial need for telecommunication equipment

Year	Expenses in US$ million
-2000	8.3
2001	4.5
2002	4.0
2003	3.3
2004	3.1
2005	3.0
2006	2.8
2007	2.7
2008	2.7
total	**34.4**

The calculation of the yearly finance need for telecommunication equipment is based on prices for equipment and spares given in the table below.

Table 3.3.2-6: Unit prices of radio equipment

no	item	unit	number	unit price US$
1	FESA	piece	18	40,000
2	FADA	piece	69	20,000
3	antennas	piece	18	8,000
4	poles	piece	18	40,000
5	switching buildings	piece	18	20,000
6	equipment of locomotives	piece	100	40,000
7	train dispatcher equipment	piece	11	25,000
8	portable radio equipment	piece	500	1,400

The calculation of the yearly finance need for cable equipment is based on prices given in the table below.

Table 3.3.2-7: Unit prices of cable equipment

glass fibre cable	600 km	US$ 15,900/km
equipment	69 stations	US$ 65,000 /piece

The financial funds required for the implementation of all measures are broken down in greater detail in Annex 3.3.2-8.

List of abbreviations used

ADM	add/drop multiplexer
CCM	cross connect multiplexer
EU	European Union
FESA	stationary railway line radio installations
FADA	train dispatcher facilities (traffic controller installations)
KVP	checking point
LWL	optical fibre cable
MESA	mobile railway line radio installations
STM-1	synchronous transfer mode with a transmission speed of 155 Mbit/s
SDH	synchronous digital hierarchy
V	volt
PCM	pulse code modulation
ZÜV	train dispatcher (supervision of train running)

Annexes

Annex 3.3.2-1	Line section Tbilisi - Poti/Batumi of GRZD
Annex 3.3.2-2	Stations of GRZD section Gardabani - Poti/Batumi
Annex 3.3.2-3	Survey of GRZD lines with signalling installations
Annex 3.3.2-4	Survey of GRZD lines with telecommunication installations
Annex 3.3.2-5	Survey of GRZD lines with telecommunication equipment
Annex 3.3.2-6	Survey of GRZD systems of telecommunication installations
Annex 3.3.2-7	Schedule of costs of signalling equipment and installations for GRZD
Annex 3.3.2-8	Schedule of costs of telecommunication installations for GRZD

Final Report Module A

Chapter 4 Financial Pre-feasibility

4 Financial pre-feasibility

4.1 General remarks

As part of the financial considerations relating to the Pre-Investment Study for the Trans-Caucasian Railway an estimation has been made of the investment costs involved in connection with the technical measures proposed.
The forecast costs consist of an estimation of the capital outlays which will be necessary to bring the line up to the required standard, as detailed in the relevant technical sections of this study. Based on these capital requirements a further estimate has been made of the annual costs involved in maintaining the line at the performance level to be attained. A further calculation has then been made of the annual depreciation charges against revenues in line with generally used rates and where possible in accordance with directives in place within the railways involved; the latest instructions being Directive No. 1072 of 22nd October 1990, published in Moscow. The detailed calculations are to be found under Annex 4.1-1 to 4.2-6.
The report is based on a mission to Azerbaijan and Georgia during the period from July to August 1996 in which data was assembled and discussions were held with relevant railway personnel. The historical data available was found to be insufficient for the purposes of the study in that the current financial situation of both railways has caused essential repairs and maintenance, which would normally be undertaken as routine measures, to be neglected. As a result the amounts reported by the railways for repairs and maintenance do not represent the charges necessary in a normal functioning operation. Therefore, the figures shown for maintenance in this report are estimates based on the experience of the experts in the various fields concerned rather than on historical experience.
In addition the devaluation of the Rouble and the subsequent conversion to local currencies in the former Soviet Union; in the case of Azerbaijan to the Manat and in Georgia to Lari, cast doubt on the reliability of the historical figures for assets.
A further complication resulting from the dismemberment of the former Soviet Union is that whereas investment decisions were previously made on the basis of the entire Soviet network, the present study concerns what was previously a fragment thereof which can now generate only a fraction of the revenues which were formerly available to cover investments.
From the study the different economic results depending on the different possible traffic levels, namely the optimistic and the pessimistic forecast within the period from 1998 up to 2015, have been calculated. Resulting from this there are two alternatives for investments for the rolling stock to be operated and maintained as well as for different developments of operational costs. In case of a better economic development of the region the optimistic traffic forecast requires the following expenditures for both railways, the AGZD and the GRZD, over the period up to 2015 in order to bring the line up to the required standard and to maintain it at the functioning level attained:

Investments	**US$ 1,152 million**
Maintenance expenses	**US$ 1,361 million**
Total	**US$ 2,513 million**

In the case of a worse economic development of the region the pessimistic traffic forecast requires lower outlays for rolling stock and following expenditures will be required:

Investments	**US$ 800 million**
Maintenance expenses	**US$ 1,295 million**
Total	**US$ 2,095 million**

The railways will need considerable support in financing this amount of capital and operational expenses, which must necessarily come mainly from international funding. It is unlikely that any great amounts can be obtained on the open market without the support of the governments involved and other international agencies.
In addition to the amounts above, **Depreciation charges** amounting to **US$ 550 million** will need to be charged against revenues over the period mentioned in order to provide for the replacement of the assets involved.

4.2 Definition of construction and equipment costs

The costs involved are calculated in US dollars and fall into six groupings: Bridges, Permanent way, Permanent way maintenance equipment, Rolling stock, Signalling and Telecommunications. For each group separate estimates were made for Azerbaijan and Georgia. The figures shown represent the capital outlays necessary to bring the line up to the required level and consist of expenditures for new equipment, construction projects and long-term renovations where feasible. The detailed tables showing a breakdown of the individual costs are contained in the annexes. Details of the work necessary are contained in the appropriate technical sections of this report. Consideration has been given to obtaining materials and equipment within the region whenever possible rather than to import more expensive products from the West.
In summary the required financial outlays for the new investments involved are contained in the following Table:

Tab. 4.2-1: Required investments for construction and equipment

Year figures in million US$	2000	2005	2010	2015	Total
Bridges	14.0	8.3	0.9	-	23.2
Permanent Way	97.2	145.2	8.0	-	250.4
Permanent Way Maintenance	38.0	33.1	-	-	71.1
Rolling Stock	14.9	7.4	125.9	283.2	431.4
Workshops	27.4	20.1	8.0	-	55.5
Signalling	32.2	132.4	56.8	33.2	254.6
Telecommunications	20.6	32.5	13.2	-	66.3
Total	244.3	379.0	212.8	316.4	1152.5

The above costs for the individual railways are broken down as follows:

Tab. 4.2-2: Required investments for construction and equipment - Azerbaijan

Year figures in million US $	2000	2005	2010	2015	Total
Bridges	4.9	5.3	0.9	-	11.1
Permanent Way	43.2	46.4	8.0	-	97.6
Permanent Way Maintenance	21.2	19.4	-	-	40.6
Rolling Stock	10.0	2.9	85.0	283.2	381.1
Workshops	10.3	9.3	-	-	19.6
Signalling	13.2	72.9	36.0	33.2	155.3
Telecommunications	13.2	18.2	6.6	-	38.0
Total	116.0	174.4	136.5	316.4	743.3

Tab. 4.2-3: Required investments for construction and equipment - Georgia

Year figures in million US $	2000	2005	2010	2015	Total
Bridges	9.1	3.0	-	-	12.1
Permanent Way	54.0	98.8	-	-	152.8
Permanent Way Maintenance	16.8	13.7	-	-	30.5
Rolling Stock	4.9	4.5	40.9	-	50.3
Workshops	17.1	10.8	8.0	-	35.9
Signalling	19.0	59.4	20.7	-	99.1
Telecommunications	7.4	14.3	6.6	-	28.3
Total	128.3	204.5	76.2	-	409.0

In estimating these requirements it has been assumed that the necessary measures can commence in 1998 and that the most urgent works will be undertaken in the three years up to and including the year 2000.

As an option the investments in rolling stock and workshops can be reduced by US$ 307.5 million in Azerbaijan and US$ 44.9 million in Georgia by delaying purchases to a later date, beyond the period of this study.

Based on these forecast investments the annual depreciation charges have been calculated as per the following tables:

Tab. 4.2-4: Accumulated annual depreciation charges

Year figures in million US$	2000	2005	2010	2015	Total
Bridges	0.6	2.2	2.5	2.5	7.8
Permanent Way	7.7	36.9	49.5	49.5	143.6
Permanent Way Maintenance	5.2	22.2	24.5	10.1	62.0
Rolling Stock	0.8	2.9	7.6	43.6	54.9
Workshops	3.3	10.0	10.9	11.3	35.5
Signalling	5.2	38.3	67.0	77.8	188.3
Telecommunications	4.4	15.1	20.7	19.1	59.3
Total	27.2	127.6	182.7	213.9	551.4

The above charges are broken down as follows for the individual railways:

Tab. 4.2-5: Accumulated annual depreciation charges - Azerbaijan

Year figures in million US$	2000	2005	2010	2015	Total
Bridges	0.3	1.0	1.3	1.3	3.9
Permanent Way	3.4	14.4	19.0	19.0	55.8
Permanent Way Maintenance	2.9	11.5	12.4	6.3	33.1
Rolling Stock	0.5	2.0	5.0	36.0	43.5
Workshops	0.6	2.3	2.3	2.3	7.5
Signalling	2.1	19.4	35.8	45.9	103.2
Telecommunications	3.2	9.8	12.7	11.9	37.6
Total	13.0	60.4	88.5	122.7	284.6

Tab. 4.2-6: Accumulated annual depreciation charges - Georgia

Year figures in million US$	2000	2005	2010	2015	Total
Bridges	0.4	1.2	1.2	1.2	4.0
Permanent Way	4.3	22.5	30.5	30.5	87.8
Permanent Way Maintenance	2.3	10.7	12.1	3.8	28.9
Rolling Stock	0.3	0.9	2.6	7.6	11.4
Workshops	2.7	7.7	8.6	9.0	28.0
Signalling	3.0	18.9	31.2	31.9	85.0
Telecommunications	1.2	5.3	8.0	7.2	21.7
Total	14.2	67.2	94.2	91.2	266.8

4.3 Definition of maintenance costs

Having defined the investments which are necessary in order to bring the line up to the required standard, as per 1.2 above, the annual maintenance costs have been estimated as per the tables below: (4.3-1 to 4.3-3).

These estimates are based on the level of maintenance required to uphold the line at the level to be attained through the recommended investments. Failure to maintain these maintenance levels will result in large repairs and deterioration of the assets within the projected lifespan for their use.

Tab. 4.3-1: Maintenance requirements

Year figures in million US$	2000	2005	2010	2015	Total
Bridges	1.4	5.1	5.9	5.9	18.3
Permanent Way	19.4	92.8	125.0	125.0	362.2
Permanent Way Maintenance	7.5	28.2	35.5	35.3	106.5
Rolling Stock	31.6	52.2	56.6	64.6	205.0
Workshops	4.8	21.4	25.1	27.6	78.9
Signalling	15.2	90.8	127.9	132.3	366.2
Telecommunications	12.1	51.0	78.7	82.0	223.8
Total	92.0	341.5	454.7	472.7	1,360.9

The forecast costs for the individual railways are as follows:

Tab. 4.3-2: Maintenance requirements - Azerbaijan

Year figures in million US$	2000	2005	2010	2015	Total
Bridges	0.4	2.1	2.8	2.8	8.1
Permanent Way	8.6	36.5	48.5	48.5	142.1
Permanent Way Maintenance	4.3	16.0	20.3	20.3	60.9
Rolling Stock	18.9	29.7	29.0	30.1	107.7
Workshops	1.8	9.4	9.6	9.6	30.4
Signalling	3.3	18.3	9.0	8.3	38.9
Telecommunications	7.5	30.3	45.0	46.7	129.5
Total	44.8	142.3	164.2	166.3	517.6

Tab. 4.3-3: Maintenance requirements - Georgia

Year figures in million US$	2000	2005	2010	2015	Total
Bridges	0.9	3.1	3.1	3.1	10.2
Permanent Way	10.8	56.3	76.5	76.5	220.1
Permanent Way Maintenance	3.1	12.2	15.3	15.0	45.6
Rolling Stock	12.7	22.5	27.6	34.5	97.3
Workshops	3.0	12.0	15.5	18.0	48.5
Signalling	11.9	72.6	118.8	124.0	327.3
Telecommunications	4.6	20.7	33.7	35.3	94.3
Total	47.0	199.4	290.5	306.4	843.3

4.4 Estimates of benefits and disbenefits

As the line in question does not have a separate administrative organisation and the accounting is made for the networks of the railways involved as a total entity, it is difficult to isolate the results of operations of the line. Nonetheless an estimate has been made of the contribution which the line makes to the result of the railways' operations. These estimates are in the case of Azerbaijan 80% up to the year 2000 and thereafter 60%. The corresponding estimates for Georgia are 75% and 60%.

Based on these percentages and the results of the calculations relating to the proposed investments an evaluation has been made in Annexes 4.4-1 to 4.4-8 of the cash flows and internal rates of return (IRR) under the optimistic and pessimistic variants.

Annex 4.4-1 shows the optimistic variant for AGZD. The variant provides a positive cash flow by the year 2000 and an IRR of 128%, which would be sufficient to cover financial expenses. In the case of GRZD however even the optimistic variant, Annex 4.4-2, does not produce a positive cash flow and no IRR during the period under consideration. The calculation does however indicate that beyond the year 2015 the cash flow becomes positive and therefore over a long period of time the line could become viable.

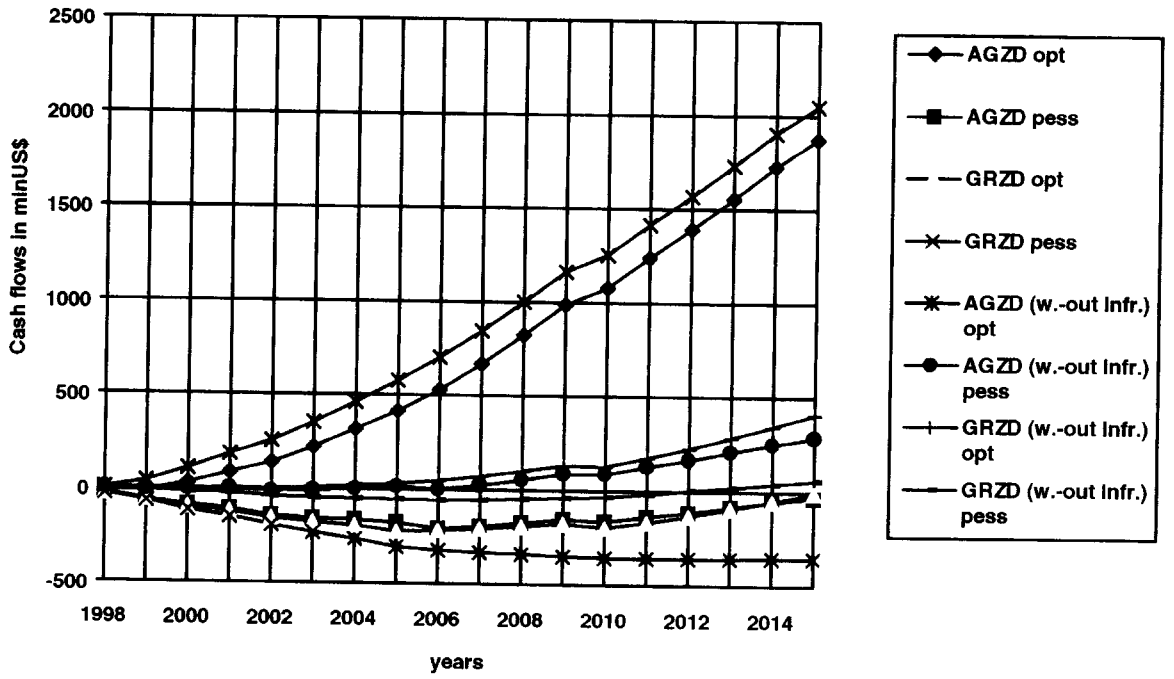
The pessimistic variants for both railways; Annexes 4.4-3 and 4.4-4, produce negative cash flows for the total period, and therefore funding problems.

In order to assess the effect of these variants in a situation where the railways were only required to cover operating expenses further calculations were made in Annexes 4.4-5 to 4.4-8. The purpose here is to separate the infrastructure investment costs and maintenance costs from those relating to operations including upkeep of the signalling and telecommunications networks. In such a case it is assumed that the infrastructure investments are assumed by the Governments involved. This would be in accord with current Western European practices where it is considered that the upkeep of the infrastructure is an unfair burden to a railway.
The results show that under the optimistic variant the Azerbaijan Railway would be in a very favourable position and the Georgian Railway would obtain an IRR of 61% with a positive cash flow from 2003 onwards. Even under the pessimistic variant AGZD would

obtain a positive IRR and a positive cash flow within ten years. GRZD however would only begin to obtain a positive cash flow in this situation beyond the year 2012.

The overall conclusion to be drawn from this exercise is that AGZD would under the favourable variant be in a position to cover financing costs but that GRZD is a problem in that the indications are that the railway is not in a position to finance the measures recommended. Only if the costs of infrastructure, both investments and maintenance, are absorbed by Government is GRZD in a position to finance the recommended measures and then only under the optimistic variant or in a time perspective which is very long-term.
In the following graphic an overview is given of the different cash flows depending on the several pre-conditions given above. The summary is that AGZD will obtain a positive cash flow in 3 scenarios (optimistic without infrastructure, optimistic with infrastructure and pessimistic without infrastructure). GRZD obtains a positive cash flow only in 2 scenarios (optimistic without infrastructure and pessimistic without infrastructure).

Fig. 4.4-1: Cash flow development



As already mentioned; the line in question is previously part of a much larger network and the benefits derived from any investment were at that time considered in the context of the network as a whole.
The line should likewise be regarded as a section of the TRACECA corridor and the return on investment considered as a benefit or necessity for the proper functioning of this corridor. This presupposes the readiness of the countries involved to co-operate and bear the financial burdens which such a project entails.

The benefits of the undertaking should therefore be looked at from a strategic point of view when considering its financial viability. In fact, given the present economic and political situation in the Caucasus region, the line can be considered as a vital link between the Caspian and Black Seas, since otherwise the transport of bulk and heavy goods on a regular basis and in the required quantities would not be possible.

4.5 Economic and financial profitability

The economic and financial profitability can only be assessed in terms of the total railway networks in the Caucasus region and the total TRACECA corridor. In view of the accounting organisations and methods presently in place further on-site analysis would be necessary to isolate the performance of the line which is the subject of this study. Such an analysis would be somewhat time consuming and under the present accounting system without guarantee of any substantial degree of accuracy.

If the line in question is to be considered independently of the total TRACECA corridor the present outlook indicates that up to the year 2015 the two railways will only be in a position to finance the investments necessary and generate income from their operations sufficient to provide for the necessary maintenance of the new infrastructure and rolling stock if the optimistic variant conditions prevail. and in the case of GRZD if the railway is relieved of the burden of infrastructure upkeep.

The governments concerned will therefore need to consider their involvement in subsidising some aspects of the operations to a great extent or an alternative solution must be found. This question can only be looked at further in the context of the financing of the measures recommended, in that decisions must be made regarding the financial support to be accorded.

As with other railway systems world-wide the solution may be for the Governments to assume ownership of the infrastructure so that the railways will only be responsible for covering the operating costs. In such a case the Governments involved will need to finance the measures recommended in this study for rehabilitation of the permanent way, signalling, tunnels and bridges etc.

4.6 Financing possibilities

From enquiries made in the countries involved it would appear that no local funding is available. It is also unlikely that at this stage private funds would be available for the major part of the investments required.

It seems therefore that at least in the early stages of the project, non-government funding will have to be from international organisations at very favourable rates. From enquiries made at the local offices of the international funding organisations the negotiations regarding such matters are not made locally but at the headquarters level. The local representatives were not able to provide further information as to funding possibilities.

In order to support the railways in preparing first steps of funding the investment and maintenance measures identified,a special

„Financing Memorandum"

was developed for both the Azerbaijan and Georgian railways and attached to this report.

As indicated in section 4.5 above the railways under review will in all likelihood only be in a position in the period foreseen in this study to generate the revenues necessary to cover the costs of the investments proposed if the economic conditions under the optimistic variant are fulfilled. It would therefore seem likely that the viable solution for the region would be for the Governments concerned to undertake the rehabilitation and maintenance of the infrastructure, so that the railways will only be required to finance their operations from the revenues generated.

For materials purchased from western European manufacturers credit facilities may be available through export funding. However, it is considered more economic to obtain the necessary materials and equipment from countries which were formerly part of the Soviet Union since in this case the costs will be lower and the equipment and materials consistent with those formerly in use.

A further alternative would be for a BOT (Build, Operate, Transfer) venture to be established to finance and operate certain aspects of the project. Such a solution could relieve the railways of part of the financial burden and provide a channel for the input of western expertise, whilst at the same time providing a source of capital funding.

A BOT venture could be the solution for certain operations on the line, maintenance activities or the operation of part of the rolling stock. The operation of maintenance workshop facilities would probably be the most suitable solution of this type, since non-railway activities can be performed at such locations. Such ventures will require the identification of suitable partners and negotiations as to shares participation, time period of the venture and similar matters. Such a solution would only seem possible where the international partners involved have a vested interest in the proper functioning of the undertaking.

Annexes

Annex 4.1-1	Bridges Azerbaijan
Annex 4.1-2	Permanent Way Azerbaijan
Annex 4.1-3	Permanent Way Maintenance Azerbaijan
Annex 4.1-4	Rolling Stock Azerbaijan
Annex 4.1-5	Telecommunications Azerbaijan
Annex 4.1-6	Signalling Azerbaijan
Annex 4.2-1	Bridges Georgia
Annex 4.2-2	Permanent Way Georgia
Annex 4.2-3	Permanent Way Maintenance Georgia
Annex 4.2-4	Rolling Stock Georgia
Annex 4.2-5	Signalling Georgia
Annex 4.2-6	Telecommunications Georgia
Annex 4.4-1	Financial Plan AGZD: Optimistic Variant
Annex 4.4-2	Financial Plan GRZD: Optimistic Variant
Annex 4.4-3	Financial Plan AGZD: Pessimistic Variant
Annex 4.4-4	Financial Plan GRZD: Pessimistic Variant
Annex 4.4-5	Financial Plan AGZD: Optimistic Variant (Without Infrastructure)
Annex 4.4-6	Financial Plan GRZD: Optimistic Variant (Without Infrastructure)
Annex 4.4-7	Financial Plan AGZD: Pessimistic Variant (Without Infrastructure)
Annex 4.4-8	Financial Plan GRZD: Pessimistic Variant (Without Infrastructure)

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Chapter 5 Further criteria and ranking

5 Further criteria and ranking

5.1 Examination of further selection criteria

As is the case with other countries of the former Soviet Union, Azerbaijan and Georgia are presently in the process of transition from a centrally directed economy to one driven by market forces. The problems of the railways must therefore be seen in this context and the achievements currently reached along this route.

As mentioned already in other sections of this report the revenues from passenger traffic are insufficient to cover costs and this situation is likely to continue for some time. In fact it is questionable whether the railways will be in a position to cover these costs in the period foreseen by this study. The problem is a socio-political one in that the level of personal incomes in Azerbaijan and Georgia is not adequate for the population to bear the increases in fares which would be required to permit these services to cover the expenses involved. A contract must therefore be made between the railways and their governments whereby the shortfall is recompensed in the form of subsidies out of the central funds if the railways are to be managed as market-oriented organisations. Under the present situation the revenues from freight traffic are in fact cross-subsidising losses in passenger traffic, which is an unfair burden on the freight sector, affecting its financial performance.

The railways are presently operating under severely harsh financial conditions: The collapse of the economies brought about by the political changes has greatly affected the railways. They are now confined to operate on a much smaller scale in which the maintenance of the systems suffers under the lack of sufficient income from their activities.

The measures recommended in this study to rehabilitate the systems require enormous financial investments, which must be repaid out of future income or outside funding. It is important therefore that the investments undertaken be sustainable. For this to happen it is essential that the necessary maintenance programmes be followed and the required reserves for replacement of assets be charged against future income. In recent years the railways have been drawing on their substance to assure continuance of operations, resulting in serious shortcomings in the maintenance of their assets, cannibalisation and depletion of capital. For the recommended measures to be effective it is necessary that these practices be replaced by strict adherence to effective measures aimed at the upkeep of the assets.

Reorganisation of the railways into newly formed profit centres would provide more financial transparency in the operations. These sectors could include passenger services and the various services offered in the freight sector, such as transit freight, containers, petroleum products etc. Budgets should be drawn up along these lines and the corresponding costs recorded in cost centres within the individual sectors. The results of these sectors would provide the necessary data to determine which services are profitable and those operating at a loss or barely covering their costs.

In the case of the passenger services for example the data provided would form a basis for negotiations at a government level concerning the subsidisation of non-profitable services.

It is therefore recommended that attention be given to these considerations in any negotiations regarding funding of the recommended measures.

5.2 Ranking of alternatives and recommendations

The annexes 4.1-1 to 4.1-6 and 4.2-1 to 4.2-6 provide a detailed summary of the recommendations of the individual experts involved in the study and the costs involved in carrying out these recommendations.

The tables may be considered to represent a ranking in themselves, since the measures which are foreseen are presented along with the timing and costs involved. The measures which are foreseen to take place within the timescale up to the year 2000 being those which are considered to be most urgent.

The following items however may be considered as requiring urgent consideration and action. They are also those measures which should receive priority consideration if only a selection of the improvements recommended can be undertaken. Details are to be found in the relative chapters and in the annexes to Chapter 4:

5.2.1 Azerbaijan

5.2.1.1 Bridges

Item	Reference	Costs	Remarks
Bridge No 56 Baku	Annex 4.1-1	US$ 1 million to year 2000	In urgent need of repair
Bridges 19 & 20	Annex 4.1-1	US$ 870,000 to year 2000	Urgent
Bridges 33 & 34	Annex 4.1-1	US$ 2.95 million to year 2000	Priority measures to be undertaken
Quarry Equip.	Annex 4.1-1	US$ 600,000 to year 2000	Urgently needed to effect bridge repairs.

For these urgent measures a total of US$ 5,450,000 will be needed up to the year 2000.

5.2.1.2 Permanent way

Annex 4.1-2 indicates the measures required to rehabilitate the permanent way in Azerbaijan. The ranking as presented may be considered to be the order of priority.

The measures recommended will require an outlay of US$ 43 million up to the year 2000 with a further US$ 46 million required in the five years which follow.

To ensure the accomplishment of the above measures equipment amounting to US$ 21 million will need to be purchased up to the year 2000 with a further US$ 19 million in the five years which follow. Approx. US$ 65 million is therefore required urgently to bring the permanent way in order.

5.2.1.3 Rolling stock

The urgent need as regards Rolling Stock over the next ten years is for US$ 10 million up to the year 2000 and US$ 3 million thereafter under the optimistic variant and US$ 5 million up to the year 2000 for the pessimistic variant..

In connection with these measures US$ 10 million will be required to equip the workshops up to the year 2000 and a further US$ 9 million up to 2005 under both the optimistic and the pessimistic variants.

Therefore an investment of US$ 8 million to US$ 13 million is urgently required over the next three years for the rehabilitation of rolling stock.

5.2.1.4 Signalling and telecommunications

The priorities here are to commence immediately on the replacement of signals, points and level crossings, in addition to improvements in repair shop facilities. Therefore US$ 16.5 million is required within the next three years.

With regard to telecommunications the measures outlined in Annex 4.1-5 may be considered to have equal priority. Therefore US$ 13.2 million will be required up to the year 2000.

5.2.2 Georgia

5.2.2.1 Bridges

Item	Reference	Costs	Remarks
Bridge No 18	Annex 4.2-1	US$ 5 million to year 2000	Very old dating from 1896.
Bridges Nos. 27, 56,65 & 79	Annex 4.2-1	US$ 1.75 million per year up to year 2000 for a total of US$ 7 million	
Renewal of sleepers	Annex 4.2-1	US$ 140,000	

5.2.2.2 Permanent way

In Annex 4.2-2 the costs of the top priorities are shown separately. These amount to US$ 70 million up to the year 2000 followed by a further US$ 112 million in the five years following.

5.2.2.3 Rolling stock

The most urgent requirements with regard to rolling stock consist in the equipping of the workshops. US$ 17 million is urgently needed for these measures up to the year 2000.

5.2.2.4 Signalling and telecommunications

The most urgent requirements here are for cable equipment and the outfitting of the Central Repair Workshops. To meet these needs US$ 5.3 million will be required up to the year 2000 followed by US$ 23 million over the following five years.

5.2.3 Summary

All the measures outlined in the Annexes 4.1-1 to 4.2-6 are considered necessary for the rehabilitation of the two railways. The above-mentioned items are however considered to be the most urgent and are summarised in the following table:

ITEM	COST (US$ millions)
Azerbaijan	
Bridges	5.45
Permanent Way	43.00
Rolling Stock	13.00
Signalling & Telecommunications	29.70
Total	**91.15**
Georgia	
Bridges	9.14
Permanent Way	70.00
Rolling Stock	17.00
Signalling & Telecommunications	5.30
Total	**101.44**
Grand Total	**192.59**