Tacis

Traceca :
Rolling Stock Maintenance -
Railways TNREG9309

Progress Report

October, 1996

Project Title	TRACECA - Railways : Rolling Stock Maintenance
Project Number	TNREG 9309
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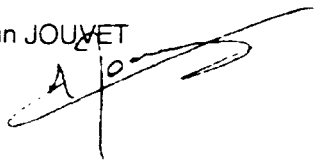
Signature	

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1. Project synopsis

Project Title		TRACECA - Railways : Rolling Stock Maintenance
Project Number		TNREG 9309
Country		All TRACECA Countries
Project starting date	:	6 March 1996 (effective date of the contract)
Project duration	:	12 months (from the effective date of the contract)

Wider Objectives Improvement of the rolling stock maintenance of the railways companies in the TRACECA countries, enabling them to operate the TRACECA corridor in the short term and ensuring continuity in the long term

Specific Project Objectives

- Short term recommendations for the maintenance management of each country, and to propose immediate actions to be undertaken on the rolling stock, on its maintenance or on the management of the supply of spare parts, equipment and vehicles
- Proposal for long term investment plans for maintenance facilities and recommendations for the supply of spare parts, in both cases whenever possible, within the framework of a market-oriented railway system.
- Transfer of know how in management of rolling stock maintenance

Planned outputs Analysis of the current situation of the rolling stock and its maintenance, rolling stock maintenance management and organisation (detailed for one of the TRACECA countries), including an assessment of economic and commercial aspects : facilities and enterprises for rolling stock manufacturing and maintenance, and for spare part production

Future requirements for new rolling stock and future rolling stock maintenance requirements, which will be based upon traffic and operational forecasts and rolling stock projections.

Proposals for future maintenance strategy and a development plan for construction or upgrading of major workshops : the development plan will include organisational, financial and economic evaluations as well as aspects of restructuring, capacity balancing and task distribution.

Case study consisting of an economic feasibility study of one proposed development project covering at least two state railways and deeply involving local staff.

Local seminar attended by two key persons of each of the railways, with two major subjects, viz., maintenance policies practised in western railway companies and discussion of the proposed maintenance strategy

A two week study tour for the two key persons of each of the railways, with two major subjects, viz., organisation and execution of rolling stock maintenance in western railways and familiarisation with western technology

2. Summary of the project progress

After a round trip of the Team Leader over the 8 countries concerned by the project, the rolling stock experts were dispatched in the different countries. They performed surveys based on terms of reference of the contract completed by specific requirements and objectives resulting from the first round trip of the Team Leader

Therefore, a survey of one to two weeks was carried out in each country between May and July 96. So as to improve the knowledge of the organisation of the railways, the train operationexpert performed a survey in two of the beneficiary countries.

The findings of these surveys enable the team to determine main orientations for further recommendations to reach a market oriented economy management which should allow them to cope with some of their financial difficulties

The railways are still working with the former organisation of the Former Soviet Union, of which its objectives fitted well the former policy, but are not applicable in a context of budget independence. The technology of the equipment suit very well that former organisation.

That technology is old, but the equipment themselves are not very old. Again, this technology fitted well with the objectives of the former policy.

The former policy was based on full employment and availability whatsoever the cost to pay for it, and whatsoever the performances and the quality of service.

The results of that policy were : large fleet of rolling stock, numerous workshops for repairs and maintenance, high responsibilities in each level of the staff but responsibilities limited in very restricted fields.

In situation of budget difficulties, the first function to suffer the consequences of budget cut off is the purchase of spare parts and it is quite obvious that it constitutes the main claims for assistance from the railways. Without spare parts for rolling stock and maintenance tooling, they are not able to carry out the maintenance properly. For some of those networks, if no corrective actions are not undertaken in a very short term, train operation will not be possible any more. Therefore, the project has been more oriented towards short term actions and short term recommendations rather than long term studies

Between alternatives which could recommend new rolling stock and new maintenance infrastructures designed in a more efficient and more reliable technology and alternatives which recommend to cope with the existing situation, the second one has been chosen as the highest priority. First of all, the second one is more realistic in term of financial capacity and secondly the rolling stock and the maintenance facilities already exist, they are not too old and the staff is well trained to use it

So, the case studies have been reinforced and one of them has already started, and the forecasts for long term were reduced in order to increase the knowledge of the present situation and in order to be more concrete for the short term recommendations

In addition, it should be noted that the surveys were successful : a fair understanding of the local situation was possible thanks to a friendly cooperation from the railways, but the difficulties to get complete or reliable information, either due to the restrictions imposed by the « secret service » who has not always given authorisation to supply information or due to some confusions in the data themselves impose. Therefore, further investigation are necessary and the data collection should continue all along the project duration so as to complete the knowledge of the situation. A better knowledge a the procedures and a more complete data base would enable the team to give concrete and realistic recommendations.

A local seminar has just been organised in Tbilisi for two representatives of every beneficiary countries. The seminar was based in mutual discussions whenever it was possible and expected by the attendants. It aimed at transferring western organisation in market oriented management and showing some experiences to illustrate the concepts and organisation developed

3. Summary of the project planning for the remainder

The project is still complying with the original time schedule and project organisation chart, however the contents of the tasks will be changed to take into account the comments arisen during the previous phase of the project, in particular, to take into account the requests of the whole TRACECA projects. The time schedule is updated according to the current progress of the study. The amendment to be born in the development of the study concern more the contents of each tasks than the organisation of the study.

As stated above, the data collection should be maintained until the end of the project, the final report will complete the data of this current report. A particular attention will be paid in the knowledge of the freight capabilities, available fleets of locomotives and wagons and facilities to maintain them.

Since the fleet quantity is rather well known, the accurate conditions of the vehicles are not well known. It is rather difficult to acquire a fair knowledge of them, the railways themselves could face problems to get such view of their freight wagons for example. Two main reasons explain that situation : the wagon fleet is so huge that it is not easy to follow up them one by one, and the pool management of the wagons does not allow the railways management to know exactly the origin and background of the wagons running on their networks.

During the following tasks of the project it will be performed :

- four case studies, in four different countries ; those case studies will allow one of the EC team expert to work in close cooperation with railways experts and managers and to assist them in solving one of their concrete problem ; those case studies will also give the opportunity to transfer experience of western maintenance concept and organisation.

- alternative recommendations for the long term ; it will be paid more attention on how to get a new technology than to define that new technology, a cost estimate will be proposed for the implementation of a new technology, proposals for future maintenance strategy complying with technology of the vehicles, and proposals for maintenance facilities.

- recommendations for the short term will be developed ; how to cope with the current situation in order to be able to run the railways in standard conditions and how to be able to achieve, in several steps, an organisation better fitted with the present economic environment, since railways organisation are heavy, they have a big inertia, and shifting to a new organisation will require time and adapted planning ;

- an analysis of the costs of the current train operationand maintenance and evaluation of future train operationand maintenance costs.

A two week study tour in France in the continuity of the seminar ; it is planned to receive the same representatives who attended the Tbilisi seminar in order to show them direct applications of the concepts and organisations developed during the Tbilisi seminar. The conferences and visits will concern organisation and execution of rolling stock maintenance and familiarisation with western technology.

4. Project progress in reporting period

4.1 Activity progress

4.1.1 Phase 1 : Current situation analysis

1 A - 2 B Mobilisation and site survey

Performed by the Team Leader, during a round trip all over the beneficiary countries. Those tasks allowed him to be aware of the difficulties of communications: telecommunications and travels between countries. In particular the physical, political and economical gaps existing between Caucasus countries and Asian countries

Team dispatching all over the beneficiary country appeared necessary to work closely with each country. Surveys for data collection were also organised at that time.

1 C Current situation analysis

Surveys of the current situation of the rolling stock and maintenance infrastructures : performed by :
Torben LOYCHE in TURKMENISTAN, TADJIKISTAN, AZERBADJAN, ARMENIA
Hasse MORTENSEN in UZBEKISTAN, KYRGHYZSTAN
Gerald BEESLEY in GEORGIA
Alain JOUVET in KAZAKHSTAN

Train operationsurvey performed by
Finn LARSEN in KAZAKHSTAN and UZBEKISTAN

The surveys in AZERBADJAN and ARMENIA complete the information gather in previous reports drawn up by TRANSURB in AZERBADJAN and DE CONSULT and SYSTRA in ARMENIA. It was not easy to Torben to get the TRANSURB report

The seminar in Tbilisi will give us the opportunity to have a better understanding of the Caucasus management of the railways Due to the geography, the economy and the population nationalism of the Caucasus area the railways management should be rather different than the railways management in the Central Asia area

Due to a certain spirit of secret and the control of the « first service » the information collected are not always reliable, some cross checking enables us to correct some of them. More checking would be needed to complete the surveys

Nevertheless the data collection gives a fair image of the situation of the railways management, the rolling stock and the maintenance infrastructures

The analysis of manufacturing capabilities were carried out without any concrete results. No railways production exists in the concerned countries except in Tbilisi where a locomotive plant is almost paralysed due to run out of locomotive orders

1 D Case study initialisation

Proposals were given to the TRACECA Project Management in Brussels, (cf. memo9613 in annex). Those proposals suit the objectives of the TRACECA projects

For those purposes

- Torben LOYCHE has started studying the rehabilitation of the tank wagon repair shop in Baku, he could need assistance in January in editing a bankable report on the feasibility of such a repair shop .

- Hasse MORTENSEN will spend two months in Bishkek to study some modification of the locomotive shop. he could need assistance in editing a bankable report .

- Alain JOUVET will spend at least two months in Tashkent to assist the railways in analysing the opportunity to develop the electric traction on the Uzbek railways. assistance in economic feasibility could also be needed

- Gerald BEESLEY should spend also more than two months in Tbilisi to assist the Georgian railways. some economic feasibility could be needed

Among other objectives. the case studies aim at transferring knowledge on Western management

1 E Current situation synthesis

Current situation synthesis has been performed through discussions held between the Team Leader and some of the experts after their surveys. The analyse of the survey reports of each country allow us to do a fair synthesis (cf. interim comments below)

The seminar of Tbilisi has given us the opportunity to discuss together on those results. It has also been the opportunity to present those findings to the representatives of the railways during the seminar.

1 F Inception report

The English version of the inception report was submitted in May. the Russian version in June. A presentation was done in Brussels on June 10th

4.1.2 Phase 2. : Requirement forecasts

2 A Traffic forecasts

Comprehensive traffic forecasts were cancelled and estimates on the traffic evolution will take place of the forecast study Results from the specific project « Traffic Modelling ». will enable us to make more accurate our assumptions and to correct them where required Those results should be available by the end of this year

In terms of traffic forecast. the surveys previously carried out. show a fast slowdown on the freight traffic and a rather constant traffic on the passenger traffic

The knowledge of the existing traffic being still partial. it will be difficult to give concrete recommendations for the countries who were unable to give us any figures on their traffic Based on the existing traffic. the Consultant is preparing the requirements for the next period

Therefore additional traffic figures should be collected during the next period

In a first approach. it will be assumed that the current traffic will be constant during the next five years. Nowadays it is still decreasing in all countries concerned by the project A freight traffic increase of 5°o per year for the five following years will be taken as assumption in order to propose a railways fleet of vehicles and their related maintenance facilities Those assumptions will be updated whenever possible New forecasts from the « Forecasting Model » project as well as any forecasts in new traffic in TRACECA corridor will taken into consideration. as soon as they will be available

2 B Operation forecasts

Related to the traffic forecasts and to the infrastructures. the train operationforecasts should define the average commercial speed and the fleet of rolling stock However. both. traffic forecasts and infrastructures conditions and proposals for improvement are not well known at that time. therefore the outputs for long term requirements cannot be done accurately

This activity carried out by Mr Finn LARSEN in July focused in the analysis of improvement of organisation and management of operation Among those recommendations. it is proposed : split between train operationand maintenance. changes to improve the efficiency of the railways and adaptation of the current organisation to cope with market economy requirements

The recommendations to be done in terms of train operationwill concern more management than accurate calculation of fleet requirements

The existing fleet of rolling stock and the maintenance infrastructure are more than required, the questions are more : how to rehabilitate the existing rolling stock and depots and how to implement a new organisation so as to increase significantly the efficiency of the systems.

2 C., 2 D., 2 E. Rolling stock, Maintenance facilities and Manufacturing requirements

At this stage of the project the fleet of rolling stock, the maintenance facilities and the manufacturing capacities required to cope with future needs which should be split into 2 phases:

- for the long term, the requirements will be defined later on, during the development of a long term strategy evaluation of rolling stock, maintenance facilities and manufacturing capacities will be performed in relation with the assumptions taken for a new technology, and a new organisation of maintenance :

- for the short term, the requirements will be expressed in terms of change or update of existing organisation so as to be able to face the current difficulties and keep the railways alive, those recommendations have been studied between the members of the team, and an overall strategy has been proposed during the Tbilisi seminar

2 G Overall strategy

If the long term requirements for operation, rolling stock, maintenance facilities and manufacturing cooperation could not be completed in September as planned, due to the reasons developed above, the overall strategy could be analysed between the four members of the team during the Tbilisi seminar and proposed to the beneficiary country representative and it could be analysed further just after the seminar, with two other members, among them was the economist of the team.

4.2 Interim comments

The following comments summarised the findings of the surveys, and attempt to propose a synthesis of the situation encountered in the whole area. The annexes of that reports give more accurate findings of those surveys for each country

As KAZAKHSTAN is the largest country and its networks and equipment are the most diversified among all the others a thorough survey has been carried out in that country, the results of that survey are not all available at the moment of editing this report, the complete findings will be given in the completion report

4.2.1 Overall

The railways are still following the former procedures of train operationand maintenance. Those procedures fitted well the old communist organisation, the railways reached their objectives and the ridership were certainly satisfied by the services proposed. The objectives in level of comfort were reached. The maintenance procedures fitted well the technology of the rolling stock

A general policy of production allowed the previous management to produce rolling stock and spare parts according to full employment policy. The railways were managed so as to provide strategic and economical links between all areas of the FSU. The maintenance procedures could be applied, since the spare parts were produced on time. The cycle of economy was not based on cost efficiency but on production and employment. The railways reached there objectives to support the government. They constituted the major tool of communication and transport whatsoever the government should pay for them. They should be reliable, available and safe. The cost efficiency and the technical performances were certainly not optimised.

Nowadays, the tight links between all areas of the FSU, are not so essential and the budget cutback affect firstly the comfort and the safety. However, even though the applications of the procedures are downgraded, there were so much precautions to ensure the reliability of the system that the reliability is often reached, excepted in the Caucasus area where the downgraded of the infrastructures do not allow to maintain a standard level of safety and reliability

Moreover the railways management are still using the procedures they have used during decades, some of the countries have tried to adapt those procedures. For different reasons, culture, ethnic origin, relationship

with Moscow. most of the railways do not have a strong willingness to change deeply their organisation as they should do to follow a market oriented management fitted with their new political environment.

The railways ridership has been maintained rather constant since the breakdown of FSU due to very low fare policy Thanks to those fare. many passengers use the railways without strong reasons to travel. The new « market oriented » economy produces a lot of unemployment. and the people do not hesitate to travel far from their own country to find a job Moreover. the FSU involved a lot of movements of the population in all the areas of the Union. therefore. the population travel frequently to meet their family sometimes far from their residences

In the meantime. the freight traffic has suffered substantial cutback mainly due to the recession of the economy after the breakdown of the FSU. The fall down is higher in Caucasus than in Central Asia

The following table gives an evaluation of the passenger and freight traffic all over the area and an attempt of the evolution during the last 5 years

	Passenger traffic		Freight traffic	
	bn pass km in 1993	Average yearly evolution	bn pass.km in 1993	Average yearly evolution
KAZAKHSTAN	20 50	0%	191.00	-15%
KYRGHYZSTAN	0 03	+1%	0.40	-10%
UZBEKISTAN	5 80	+1%	39.00	-20%
TURKMENISTAN	1 80	0%	23.10	-15%
TADJIKISTAN	0 13	N/A	2.15	N/A
AZERBADJAN	0 80	-10%	2.30	-90%
GEORGIA	N/A	N/A	N/A	N/A
ARMENIA	0 17	-20%	0.41	-200%

Many positions of management and engineering were held by Russian educated people. Most of them came back to their countries at the breakdown of the FSU Due to the exodus of those engineers and managers to their own country some lack of competence are suffered in the management. and in the workforce of the railways

The railways are still in charge of social activities welfare. school. accommodation. The railways are not specialised in the management of such ancillaries activities which are costly and which should certainly not offer the services of the specialists of the fields who benefit of a larger organisation. Most of the beneficiaries railways would like to withdraw those activities. but in some cases they could not forget their social responsibilities

In order to guarantee the reliability of the system. a punishment policy is still used. It could be applied at every level of the hierarchy Every level of the hierarchy has strong responsibility, but in general in a very closed field

Due to that policy nobody is very keen to take any risks. Therefore. the system is far from an optimised system Redundancy and low performances ensure fair results in terms of reliability but not in terms of cost efficiency speed and services The objectives of every level of the hierarchy are oriented towards the immediate hierarchical upper level. never towards the customers who have to suffer the general policy.

4.2.2 Networks

Even though the eight countries concerned by the project have a lot of similar characteristics, the Caucasus and Central Asia areas are different in :

- dimension : the Caucasus area is smell and mainly mountainous, while the Central Asia is wide, the distance to be covered are not in the same range. It is easy to run a train with the same locomotive and the same driver through each of the Caucasus country, which is not the case in the Central Asia countries.

- the railways of the Caucasus countries are electrified on most of their lines. The power supply energy at 3 300 V DC. the Central Asia countries are few electrified when they are the power is given by 27 000 V 50 Hz power supply.

	State area	No. inhabitants	Length of network	No. of stations
KAZAKHSTAN	2 725 000 Km²	17 000 000	13 500 Km	about 900
KYRGHYZSTAN	199 000 Km²	4 500 000	424 Km	about 20
UZBEKISTAN	447 400 Km²	22 100 000	3600 Km	about 300
TURKMENISTAN	488 000 Km²	4 400 000	2198 Km	125
TADJIKISTAN	143 000 Km²	5 600 000	423 Km	29
AZERBADJAN	86 600 Km²	7 700 000	2125 Km	177
GEORGIA	69 700 Km²	5 700 000	1600 Km	158
ARMENIA	29 800 Km²	3 500 000	845 Km	72

The conditions of those networks are different, but all of them claim to get difficulties to main their network, mainly the track infrastructures. The track is so downgraded in Caucasus countries that they should have reduced the maximum speed up to 20 km/h in some areas, those conditions have a major effect in the train operation efficiency and in the maintenance of the rolling stock which suffer those conditions. In Central Asia the track conditions are better in the main lines, but the Asian railways face the same difficulties in secondary lines

The electricity supply is fair in Central Asia countries but most of their lines are not electrified, even though the total length of electrified lines is greater than the length of electrified lines in Caucasus. But in Caucasus, where all main lines are electrified, the electric power could not cover the needs of the railways. In some area, where the line voltage decreases too much, they should cancel electric train operation in order to put the minimum locomotives in the line (the more locomotives they put, the more the line voltage fall down).

Few lines are fitted with double tracks, which is a wide constraint to increase the average speed. Nevertheless, those networks were able to manage very high passenger and freight traffics. Therefore they could increase again the current traffic, the infrastructures allow them to do so, but they would have difficulties to increase the traffic, the performances and the efficiency at the same time.

4.2.3 Operation

In terms of operation, the former FSU network was a star network centralised in Moscow. It is still the current organisation. The domestic passenger services are still a portion of the routes to Moscow.

To take place of the former centralised management of Moscow, an international council has been set up in 1992, between all the former states constituting the Soviet Union. This council still has its headquarters in Moscow and holds coordination meeting in one of the member countries every 6 months. This council proposed time tables, fare policy and coordinates the use of wagons of all the FSU. As a consequence of that coordination, freight services are ordered in a country, the railways could request the council to get wagons they need for the transportation of goods and do not manage the way back of the wagons which could be sent to another country by the council.

Some data about the different networks and the infrastructures managed by the train operationdivisions

	Length of double track	Length of electrified	No. of employees	No. of loco workshops	No. of coach workshops	No of wagon workshops
KAZAKHSTAN	3540 Km	3300 Km		42		
KYRGHYZSTAN	-	-		1	2	3
UZBEKISTAN	680 Km	480 Km		11	3	22
TURKMENISTAN	-	-	30000-6800	3	2	5
TADJIKISTAN	-	-	7 000	3	1	1
AZERBADJAN	800 Km	1280 Km	48 000	6	2	6
GEORGIA	268 Km	1600 Km		5	1	1
ARMENIA	-	845 Km	6500	2	1	2

4.2.4 Rolling stock

Generally speaking, the quantity of rolling stock is more than enough in every country to cover the train operationrequirements, but several remarks should be pointed out :

- The average age of the fleet is 15-20 years old, which should cover the needs during at least 10 years. In Caucasus countries the fleet is rather older and some actions should certainly be necessary to renew part of some of them
- The technology is old and not efficient but certainly reliable when the procedures could be applied. The maximum speed of locomotives is 100 km/h. But in most cases the track does not allow to run at such speed. The consummation looks rather high
- Line locomotives are always run in twin or triplet sets fitted with 3-axles bogies for the diesel locomotives and 2-axles bogies for the electric ones, which would not be necessary in most cases of operation. However, the railways do not take any risks to face break down on line and are keen to maintain such arrangement. Moreover, the locomotives are fitted with only one driver 's cabin which require to reverse the locomotives on their way back, if they are coupled in twin sets.
- As 2 or 3 teams of drivers are attached to each locomotive, the maximum running time of a locomotive hauling a train is 6 to 8 hours which allows the locomotives to run less than 300 km before coming back to the attached depot

Quantity of locomotives spread all over the study area

The following table gives the total number of locomotives and the unavailable ones. The unavailable locomotives include the reserve fleet and the ones which are out of service, in most cases they should require major repairs to be rehabilitated

The « Diesel locomotives » are mainly 2-unit sets or some are 3-unit sets. The table gives the total number of units (or vehicles)

The « Electric locomotives » are 2-unit sets locomotives, the table gives the total number of this kind of locomotives whatsoever the line voltage for which they were designed. It is pointed out that in the Central Asia area those electric locomotives are supplied by 27 kV 50 Hz, whereas in the Caucasus countries, the overhead catenary is supplied with 3.3 kV DC

The shunting locomotives are all single unit set fitted with 3-axles bogies. They are all diesel locomotives.

Breakdown of the fleets of rolling stock

	Locomotives	Passenger coaches	Wagons
KAZAKHSTAN	5486	>3000	101 300
KYRGHYZSTAN	94	529	2 600
UZBEKISTAN	1568	1454	32 529
TURKMENISTAN	331	285-400	12 800
TADJIKISTAN	67	355	2 112
AZERBADJAN	520	700	31 300
GEORGIA	436	1176	19 800
ARMENIA	149	290	4 835

In particular, breakdown of the fleet of locomotives

	Diesel locomotives	Electric locomotives	Shunting locomotives
KAZAKHSTAN	3424	1423	639
KYRGHYZSTAN	71	-	23
UZBEKISTAN	1082	173	313
TURKMENISTAN	233	-	98
TADJIKISTAN	46	-	21
AZERBADJAN	64	277	179
GEORGIA	9	248	179
ARMENIA	-	149	62

4.2.5 Maintenance

The overall organisation is linear : all the locomotive workshops deal with operation, management of drivers, first levels of maintenance (TO, TR1 and TR2 cycles) and according to the level of equipment of their facilities they perform overall maintenance

The number of maintenance facilities are generally more than required for the light maintenance and standard repairs, but they very few major overhaul shops. However, some countries have some deficiencies which were mainly due to the definition of the new borders. The workforce is skill and the workshop were fitted with full relevant tooling and maintenance equipment. Main of the workshops are able to design and fabricate the specific tooling, trolley or other handling equipment they need.

The procedures of maintenance and the periodicity of inspection of each type of vehicle suit quite well with the technology of the rolling stock, however, some modifications should certainly possible to decrease the frequency of some of the maintenance tasks

maintenance of locomotives, passenger coaches and wagons are generally carried out in independent shops. Each depot or workshop is fitted with all specialised shop and all specific tooling required to carry out all the level of maintenance the workshop is designed. For example several workshops of a same country is fitted with a specialised shop for brake system

Major overhaul should be carried out in manufacture plant. so for the diesel locomotives of Central Asia, in Ukraine and Russia. Due to lack of budget, in many cases this maintenance is not carried out. Therefore, idle locomotives take place of the locomotive to be maintained. In few cases, the major overhaul maintenance is carried out in the overhaul workshop of its country of attachment.

Few care is brought to security of workers.

The cleanliness of the shops does comply with Western standard. which could be acceptable for mechanical equipment. but technically speaking a fair level of cleanliness should be applied for the maintenance of some equipment such as bearings or motors

The major complaints of the workshop management is the lack of spare parts to carry out their tasks as it is mentioned on the procedures. Second hand spare parts are often used. Those spare parts come from idle vehicles or worn spare parts repaired by the depot itself.

It is to point out that in most cases the depots and workshops are very keen to find alternative solutions to their daily problems of spare parts

4.2.6 Manufacturing

Most of the rolling stock manufacturing plant are located in Ukraine. Check republic, and Russia. One plant for electric locomotive is located in Tbilisi

Most of the spare parts manufacturing plant are also located in Russia. Some of the CIS countries are implementing a certain production of spare parts in their own country. But they face several difficulties :

- They do not get drawings and technical specifications of the equipment, therefore, they are not able to manufacture some equipment or spare parts, mainly those which are related to security
- Manufacturers could find a market in their own country, but they would have difficulties to sell their production to neighboured countries Neighboured countries will always prefer to buy to Russia than to buy to a neighbour. firstly. they are not confident on the quality and on the reliability of the production of the other CIS country. mainly due to the exodus of competencies after independence and secondly in both cases they should pay in hard currency an equivalent invoice. The size of the domestic market could not justify the production of most of the spare parts
- Authorisation of operating wagons and passenger cars outside of their countries (also locomotives, but they do not leave their countries of attachment) with equipment bought in non authorised manufactures which they should be certified by a Russian Quality Control Office.

Some projects of implementation are in progress in some of those countries in collaboration with foreign countries which generally are not in the CIS countries and European countries.

Technical capabilities exist in every country. but lack of cash flow prevent them from any implementation. To cope with that difficulties some countries (KAZAKHSTAN. UZBEKISTAN and KYRGHYZSTAN) signed an agreement to develop a mutual cooperation for the production of spare parts.

4.3 First approach of recommendations

4.3.1 Overall strategy for the future

The main reasons to change something in the organisation are more imposed by the economic situation of the railways than the technical resources The new economy of the countries requires cost efficiency and performances in order to maintain. and when possible increase the number of customers, or at least. not to loose market part to the benefit of other transport modes To cope with the new market constraints the objectives should be oriented towards the customers instead of internal objectives of production and fear of management

In order to increase efficiency and performances three main alternatives could be proposed :

- implement a new technology which requires to implement a new market oriented organisation, purchase new rolling stock, build new maintenance facilities and train all categories of staff to enable them to maintain that new situation and gain market portions ;

- define the means and the organisation which could cope with the new objectives using the existing equipment and facilities ;

- change the oldest vehicles by new ones of the same technology

Taking into account the large and not very ofd fleets of rolling stock available in most of the concerned countries, the existing maintenance facilities and the capabilities of the personnel to deal with the existing equipment, there is no needs to buy new equipment in the same technology. That would neither solve the difficulties of organisation, nor the difficulties for spare parts supply and will not allow to increase the efficiency and the performances of the systems.

Therefore, the Consultant recommends not to purchase any locomotives, passenger cars or freight wagons of the same technology, the maintenance and the rehabilitation of the existing equipment should allow the railways to cope with their short term requirements.

The feasibility of the first alternative should certainly be easy to prove, but that alternative requires several years to be implemented therefore it should be initialised soon, however, the financial resources required for the implementation of such an alternative are not available. Moreover, the quantity and the age of the existing equipment could allow to maintain alive the railways during the 5 to 10 years required to implement a new technology

A synergy between the CIS countries could help provide rolling stock, and experienced personnel for the countries which could not cope with the situation with their own fleet of vehicles.

But, certainly, a new technology of rolling stock will be suitable for a medium or a long term plan. A new technology of rolling stock together with a improved infrastructures, will enables the railways to increase their performances, therefore, to implement new services able to compete with the other modes of transportation

Taking into account the large market constituted by the TRACECA corridor, it should certainly viable to set up a local production adapted to the requirements and the infrastructures of the area.

In order to design the most suitable rolling stock and to implement a local manufacturing, years of efforts, studies and negotiations will be required. Therefore, the initialisation phase should start soon.

Initialisation phase consists in preliminary design, tests of technology and negotiations for local cooperation

4.3.2 Urgent actions to be undertaken

For the short term period, it is urgent to take actions to maintain or to rehabilitate the existing vehicles. The priority of those actions is certainly the supply of spare parts.

The supply of spare parts is a complex problem which requires

- to have a fair knowledge of which type and quantity of vehicles are needed and only the just necessary, what requires to know traffic and which train operationorganisation in order to plan the just required quantity of spare parts

- to implement an efficient Management Information System which will enable a thorough follow up of the Mean Time Between Failures of the rolling stock and its equipment, sub-equipment, spare parts and consumable, such a follow up should enables a strict policy of purchase and research of reliable spare parts

- to implement a financial follow up controlled by a third and independent party who monitor the purchase policy and help find the financial balance between minimisation of storage and risk of lack, this independent party would ensure the right use of funds, for example by split between the services who order the purchases and the services who pay the purchase ;

- a synergy between countries to produce spare parts and promote exchange in order to limit the cost of production and decrease the supply delays. such local production requires among other things, to get the technical specifications of the complex spare parts and requires to set up an International Quality Control Service who will certify the quality of the production of the local manufacturers and will authorise the use of the so-produced spare parts on the railways (certificate always required by Moscow and delivered only to Russian factories and main plants)

At the same level of priority, the training of the railways management in the possibilities to cope with the new constraints of market economy and the solutions adapted by some western countries. The recommendations and local training given during the duration of the project could be enough to arouse the curiosity of the railways but the reality is so different between the two systems that even with a high willingness of change. the railways management could not adapt such new concepts in few months of cooperation

At a second level of priority. but still as short term recommendations. new maintenance organisation could be implemented progressively to reach a four level maintenance organisation. The first level cope with the train operationinspections and light repairs while the fourth level has an industrial organisation far from the daily constraints of operation. but works as a supplier of the third level.

Such an equipment oriented maintenance will ease synergy between workshops of a same country and will facilitate cooperation between countries Moreover. such organisation will allow private sector to enter in the maintenance and in the supply of spare parts of railways. Progressively. the involvement of the private sector could be applied to the upper levels

In the same time some specific improvements could be tested to increase the efficiency of the existing workshops and one of the major recommendations for changes will concern the split of functions. Firstly inside the railways which should deal with their own field of activity. the train operationof railways. Secondly between train operationand maintenance where the functions of train operationshould be isolated from the inspection and light repair. as well as this function of inspection and light repairs should be isolated from the overhaul maintenance and heavy repairs or repairs of specific equipment.

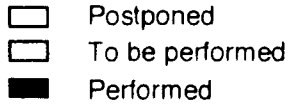
Another alternative constituting by the set up of a new independent company for operation of freight traffic by using only track infrastructures of the railways and electric overhead supply wherever it is available and useful

4.4 FORM 2.2 :PROJECT PROGRESS REPORT

Project title :TRACECA / Rolling Stock Maintenance - Railways	Project number : TNREG9309	Countries :ARMENIA, AZERBADJAN, GEORGIA, KAZAKHSTAN, KYRGHYZSTAN, TURKMENISTAN, TADJIKISTAN, UZBEKISTAN	Page :1
Planning period : 06 / 03 / 96 to 06 / 03 / 97	Prepared on :15 / 10 / 96	EC Consultant : SYSTRA SOFRETU SOFRERAIL	

Project objectives :Provide recommendations to solve existing problems in railways rolling stock maintenance

No	MAIN ACTIVITIES	TIME FRAME												INPUTS			
		1996										1997		EC Consultant		Counterpart	
		MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	Planned	Utilised	Planned	Utilised
1	CURRENT SITUATION													9 M x M	9 M x M	10 M x M	10 M x M
2	REQUIR. FORECASTS													15 M x M	7 M x M	6 M x M	3 M x M
3	FINAL REQUIR.													8 M x M	1 M x M	4 M x M	1 M x M
3 A	LOCAL SEMINAR													2 M x M	2 M x M	4 M x M	4 M x M
3 B	STUDY TOUR													1 M x M		8 M x M	
										TOTAL				35 M x M	16 M x M	32 M x M	18 M x M



4.5 FORM 2.3 : RESOURCE UTILISATION REPORT

Project title TRACECA Rolling Stock Maintenance - Railways	Project number TNREG9309	Countries ARMENIA, AZERBADJAN, GEORGIA, KAZAKHSTAN, KYRGHYZSTAN, TURKMENISTAN, TADJIKISTAN, UZBEKISTAN
Planning period 06 / 03 / 1996 to 05 / 03/ 1997	Prepared on 15 10 1996	EC Consultant SYSTRA SOFRETU SOFRERAIL

RESOURCES/INPUTS	TOTAL PLANNED	PERIOD PLANNED	PERIOD REALISED	TOTAL REALISED	REMAINDER AVAILABLE
PERSONNEL					
EC Coonsultant	35 M x M	21 M x M	19 M x M	19 M x M	16 M x M
Local Consultant	32 M x M	20 M x M	15 M x M	15 M x M	17 M x M
Sub-total					
EQUIPMENT AND MATERIAL					
Computer	-	-	1 set	1 set	-
Sub-total					
OTHER INPUTS					
Local seminar	1 week	1 week	1 week	1 week	-
Study tour	2 weeks	-	-		2 weeks
Sub-total					
TOTAL					

4.6 Overall output performance plan

Project title TRACECA Rolling Stock Maintenance - Railways	Project number TNREG9309	Countries ARMENIA, AZERBADJAN, GEORGIA, KAZAKHSTAN, KYRGHYZSTAN, TURKMENISTAN, TADJIKISTAN, UZBEKISTAN	Page
Planning period 06 / 03 / 1996 to 05 / 03/ 1997	Prepared on 15 10 1996	EC Consultant SYSTRA SOFRETU SOFRERAIL	

Outputs (to be described and target dates indicated	Agreed Objective Verifiable Indicators	Constrains and Assumptions C/A
Inception Report Englisn version 1996 - end week 20 - 17 may Englisn version 1996 - end week 21 - 24 Mai **Project Progress Report** Englisn version 1996 - end week 45 - 4 Nov. Englisn version 1996 - end week 47 - 18 Nov **Final Report** Englisn version 1997 - end week 10 - 7 mar Englisn version 1997 - end week 12 - 21 Mar **Local Seminar** 1996 - week 40 - 30 Sep **Study Tour** 1996 - week 47 & 48 - 18 Nov		- Russian translation requires 1 to 2 weeks - Report Agreements of 8 beneficiaries require time and travels or communications - Inputs from other project could delay the project - Specific requests of the beneficiaries could modify the schedule

5. Project planning for the next reporting period

5.1 Overall

The next reporting period will start in October and will finish in February 97. During the next reporting period the Consultant will perform four case studies, described below, and will finalise the short and long term recommendations for changes and recommendations to cope with the changes.

5.2 Case studies

5.2.1 AZERBADJAN - Tank wagon maintenance

5.2.1.1 Context

The depot of the tank wagons was built in 1920 on an old locomotive depot built in 1893. At the time of the break up of the Former Soviet Union the Azeri Railways planned to extend and modernise the depot, but due to the economic recession, they could not afford implementing their ambitious plant.

Rehabilitation of the building and installation of new machinery will bring the Azeri Railways the required means for the maintenance of the tank wagons.

5.2.1.2 Objectives of the study

- Draw up bankable report and technical report allowing immediate implementation of rehabilitation of the building

- Immediate assistance to the depot management to cope with immediate difficulties

- Transfer of know how in depot management

5.2.1.3 Work program

- Analysis of the required capacity of the plant, taking into account the maintenance and the repair of : the existing fleet of the Azeri Railways, an increase of that fleet and a part of the future TRACECA fleet

- Analysis of the condition of the existing machinery and proposal of rehabilitation, replacement and purchase of new machinery and tooling

- Drawing up guide lines and layout of alternatives. Analysis of the rehabilitation of the building : roofs, walls, lighting, ventilation.

- Analysis of the possibility of implementation of a painting shop on the same location.

- Study of an implementation program including a task organisation enabling maintenance and repair during rehabilitation of the plant.

5.2.2 UZBEKISTAN - Fleet locomotive analysis

5.2.2.1 Context

On the 3660 km of the Uzbek network, about 15% is electrified. Among the 875 line locomotives, about 10% are electric locomotives. A national program of line electrification is still in progress, and every year, about 100 km are electrified. The electric locomotives are rather old, and the main depots were designed for diesel locomotives.

The Uzbek Railways are requesting cooperation with EU expert to analyse the situation of the existing fleet of electric locomotive and their maintenance facilities and to draw up a program of rehabilitation and purchase of electric locomotives and their relevant maintenance facilities in order to set up an electric locomotive fleet fitting with the existing and the future electrified networks.

5.2.2.2 Objectives of the study

Report on benefit of electric locomotives

Program of rehabilitation and purchase of electric locomotives

Transfer of know how in locomotive technologies.

Transfer of know how in train operationand maintenance management

5.2.2.3 Work program

- Analysis of the condition and age of the working and idle electric locomotives,

- Analysis of the maintenance capacity of the facilities for the electric locomotives

- Comparison of the costs of train operationand maintenance between diesel and electric locomotives, analysis of savings due to higher performances and lighter equipment of electric locomotives.

- Cost estimates of locomotives

- Evaluation of the fleet of electric locomotives in relation to the electrification program.

- Evaluation of the maintenance facilities

5.2.3 KYRGHYZSTAN - Modification of the BISHKEK workshop and Assembly of axles

5.2.3.1 Modification of the BISHKEK workshop - Context

The Kyrghyz Railways are not fitted with the minimum infrastructures allowing them to get normal independence, they cannot exchange a diesel engine by themselves, and they cannot perform yearly maintenance by themselves. Firstly, that situation is costly in foreign currency and in transfer time which requires more spare locomotives and secondly that situation requires daily communications with other networks which again is time consuming and a limitation in autonomy

The Bishkek workshop is currently fitted with 5 ton cranes which enable most of maintenance works and repairs but which is not enough to lift a diesel engine from a locomotive. Such an operation is required in TR3 and KR1 cycles of maintenance and also required for repair of diesel engine. No workshop in KYRGHYZSTAN are fitted with such equipment

- Undertake TR3 and KR1 maintenance for locomotives. the frequency of TR3 is 2 years and KR1 is 5 years. the frequency of KR2 being 10 years could be subcontracted to other workshop well fitted for that maintenance program.

- Engine exchange for repair. (but also exchange of all kind of equipment)

The workshop so modified could be managed in an equipment oriented maintenance and managed separately from the main workshop and independently from operation, therefore, it could be worked as a subcontractor of the railways.

5.2.3.2 Modification of the BISHKEK workshop - Objectives of the study

- Bankable report, which will enable immediate implementation of the modifications, and which will evaluate the economic benefits of such an improvement.

- Transfer of know how in workshop management

5.2.3.3 Modification of the BISHKEK workshop - Work Program

- Evaluate the maintenance requirements in terms of yearly operations ;

- Evaluate the infrastructure modifications : raising of the walls and the roof, pillars reinforcement, working platforms to be built.

- Evaluate the workshop equipment to be purchased : crane, trolleys ;

- Perform an economic feasibility .

- Define an implementation program .

- Draw up a bankable report.

5.2.3.4 Assembly of axles - Context

The supply of wheels is one of the main problems faced by almost all the railways of the TRACECA countries. a production of wheels should be organised in one of those countries, but the minimum that a railways company should be able to do, is to buy the basic spare parts, the monobloc wheels or the ring of the wheels. and to be able to assemble them on the axles.

The Kyrghyz Railways are not fitted with powerful equipment to assemble and disassemble wheels on axles or rings on wheels, therefore, they have to purchase from foreign countries the complete axles with wheels, which is costly since the axles themselves are not worn. Specific agreement should be possible to return the worn axles in order to get new wheels on second hand axles, but the handling is complicated and the control of such tasks far from their origins is unsafe and costly.

The life time of some of the wheels could be short (600 000 km, about 1 year), therefore, even for a small fleet of vehicles this purchase of complete axles could be a major constraint for the railways, and another form of dependency which could be avoid easily by the purchase of specific tooling and a modification of the workshop .

5.2.3.5 Assembly of axles - Objectives of the study

An economic feasibility will be performed by comparison of the required purchase of wheels (including the analysis of the different possibilities of supply in the area, with the savings made by the local production including the investment of tooling

5.2.4 GEORGIA : Analysis of rehabilitation of the fleet of the freight wagons

5.2.4.1 Context

As a consequence of the independence. the wagon fleet of the Former Soviet Union has been split between the CIS A numerous amount of wagons has been allocated to Georgia Many of them cannot be used for freight operation due to their poor conditions Moreover, due to the slowdown of the freight traffic such quantity of wagons is not necessary

One of the team experts will work in close cooperation with the railways to find a policy of renewal of the fleet of wagons Some foreign investors and suppliers have already expressed their interest in buying raw materials of old wagons and provide new one will be analysed Some other alternative involving different foreign companies will be studied The former provider of wagons could constitute another alternative for supply or rehabilitation of some wagons

5.2.4.2 Objectives of the study

- Proposed alternatives of renewal of the wagon fleet

- Performed a cost estimate and profit estimate of the proposed alternatives

- Enhanced foreign involvement whenever possible.

5.2.4.3 Work program

- Analysis of the quantity of wagons to be scrapped. a tentative of sorting of the wagons according to their conditions will be carried out. in order to evaluate the quantity of wagons which could be rehabilitate.

- Analysis of the foreign proposals already available

- Prepare short terms of reference to promote the deal and to be proposed to other investors and suppliers.

- Call for interest of other foreign investors and suppliers

- Analysis of the alternatives and cost evaluation

5.3 Long term recommendations

During that next period the Consultant will draw up strategies to lead to the implementation of a new technology. The implementation of a new technology will require :

- synergy between countries for the design, the construction of the equipment and the spare parts, taking into account that such a wide program requires large personnel and financial resources, the implementation requires large capabilities and technical resources that one country could not be supply easily and quickly ;

- agreement on a financial and technical program which defines the objectives to be reached, the organisation in compliance with the objectives and the capabilities and availability of the technical and financial resources ;

- test equipment before adopting a technology, such tests could be performed independently of the general implementation, such tests have already been planned by some railways

Based on those recommendations the Consultant will make some assumptions and will evaluate the equipment and facilities related to these assumptions. Such evaluation will be proposed as an example of cost of development of a new technology. For the time being too much assumptions on the traffic, on the organisation, on the future conditions of the track infrastructures, on the availability on the energy supply, on the choice of train operationobjectives in terms of services to be provided and in terms of quality of service, could not enable anybody to draw up a concrete and realistic investment plan for a long term period based on a new technology.

5.4 Short term recommendations

As it has been presented above, the short term recommendations will aim at keeping the system alive and the possibilities and conditions of operating freight services along the TRACECA corridor.

The recommendations proposed above in the paragraph 4.3. will be developed; a program of implementation will be prepared and a cost evaluation of the recommendations will be presented whenever it is relevant

A thorough analyse of the existing rolling stock and possible synergy of use this existing rolling stock between the concerned countries. The objective of that analysis is to determine the available locomotives and wagons which could be used for the train operationof the corridor

In that intend, for the railway administrations in Caucasus and Central Asia respectively, the following will be performed :

- Present volumes of transport : type/volume, nationally/internationally
- Composition of new train system (block trains) : destination, frequencies, train size.
- Based on wagon turn-around time schedules, determine quantities of rolling stock, including reserve for operation and maintenance, required to operate the trains identified above : locomotives, wagons (type)

In relation to the rolling stock, the maintenance facilities available will be appraised and a program of use, rehabilitation or improvement will be performed;

Such analysis should lead to a cost evaluation of the train operationand the maintenance of the existing equipment, and therefore, taking into account some recommendations of improvement, a cost of train operationand maintenance of the rolling stock useful for the TRACECA corridor will be proposed.

It will be evaluated economic and financial conditions:

- income
- expenses : operational cost, maintenance costs, investment

5.5 Table : Overall Plan for operations

Project title TRACECA / Rolling Stock Maintenance - Railways	Project number TNREG9309	Countries ARMENIA, AZERBADJAN, GEORGIA, KAZAKHSTAN, KYRGHYZSTAN, TURKMENISTAN, TADJIKISTAN, UZBEKISTAN	Page 1
Planning period 06 / 03 / 96 to 06 / 03 / 97	Prepared on 15 / 10 / 96	EC Consultant SYSTRA SOFRETU SOFRERAIL	

Project objectives Provide recommendations to solve existing problems in railways rolling stock maintenance

No	MAIN ACTIVITIES	TIME FRAME												INPUTS			
		1996										1997		EC Consultant		Counterpart	
		MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	Planned	Utilised	Planned	Utilised
1	CURRENT SITUATION													9 M x M	9 M x M	10 M x M	10 M x M
2	REQUIR. FORECASTS													15 M x M	4 M x M	6 M x M	3 M x M
3	FINAL REQUIR.													8 M x M	1 M x M	4 M x M	1 M x M
3 A	LOCAL SEMINAR													2 M x M	2 M x M	4 M x M	4 M x M
3 B	STUDY TOUR													1 M x M		8 M x M	
										TOTAL				35 M x M	16 M x M	32 M x M	18 M x M

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Traceca :
Rolling Stock Maintenance -
Railways TNREG9309

Progress Report - Annexe

October, 1996

ANNEXE

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Chapter 1 Presentation and common characteristics

1. Annexe presentation

Each following chapter presents the specific findings of the surveys and some first recommendations based on the requests expressed by the representatives ot the railways during the visits

As stated in the Progress Report. the different countries owned the rolling stock fabricated during the Former Soviet Union. therefore they owned the same types of rolling stock and they use the same procedures for its maintenance.

This chapter aims at presenting the common characteristics of the rolling stock fleet and the maintenance procedures Some of those countries have adapted the maintenance procedures in relation to their financial and technical capabilities The different following reports presents those adaptation whenerver they have been explicitated to the Consultant

During the visits. rhe representatives have expressed some requests and the projects expected to be implemented in their country Those following chapters present those requests and projects as they were expressed the Project Completion Report will synthetise those requests and projects and will integrate them in the strategy of change whenever they will suit the general strategy of the recommendations

2. Train operation features

2.1 Description of the current situation

2.1.1 Overall

The situation in both Kazakhstan and Uzbekistan is characterised by them being new. independent states that after the independence of the USSR in 1991 have been in a difficult change process into for example market economy. administration and improvement of the infrastructure. etc

This change process has for example meant a substantial recession in the now independent countries with similar implications to production. trade. finances and the like.

Even though the railways in Uzbekistan already in 1988 took the step to found an independent railway company these are very young companies with the task of operating. administer and expand the railways

2.1.2 The competitive position

And the preconditions are not the best The recession is also noticeable to the railway companies. Since the independence of the countries. there has been a dramatic falls in the amount of transported freight The reduction in the number of transported passengers has been less pronounced.

The transition to market economy. which also implies a liberalisation of the transport sector. means aggravated competitive conditions For the railways the competitive position is already noticeable. as for both the freight service and for passenger service. market shares are lost to vans. coaches and private cars

The competitive position for the railways has at the same time worsened as a consequence of the fact that in the companies themselves. there are no money for maintenance and expansion/renewal of the

infrastructure and the rolling stock. It has not been possible either to be granted the necessary capital from the countries governments The consequence can already be felt, as e.g. the speed of the trains on large parts of the rail network has had to be reduced to 30-40 km/h with an increased time of travelling and of transportation as a consequence In relation to this, it should be further estimated whether a dramatic reduction of section speed, as is the case, can be avoided by a reduction of the highest permissible (and in practice existing) load per axle

To this must be added the problems in connection with maintaining rolling stock and especially the possibilities of renewing the stock fleet, where in particular locomotives and passenger coaches are of an earlier date, and where passenger coaches have a comfort level, which cannot comply with the competitive requirements As to the transport of goods, the railway companies can hardly meet the transport buyers' need for acquiring new types of wagons that are brought in line with new and altered transport requirements

Compared with other competitors, the competitive position of the railways is unequal seen in relation to the infrastructure Whereas the railways are burdened with costs for management, operation, maintenance, renewal and expansion of the infrastructure, the infrastructure is more or less made available to the other competitors for free This means that the railways have a very hard time or cannot at all compete on price parameters

This is seen in Uzbekistan in relation to the many long-distance bus services, which after the liberalisation have been created in direct competition with the railways.The ticket fares of these busses are lower than those of the railways As to freight transportation and in order to create a balance in the profit and loss account the railway has to cover the deficits of the loss-making passenger service by raising the rates for freight service

Thereby the price level for railway transportation will be higher than the market prices, with a loss of market shares as a consequence In the first half of 1996 there has been a deficit on passenger service of 22 million USD in Uzbekistan

The fares for rail passenger service have not been liberalised, but are determined by the government. To minimise the deficit various loss-making trains are discontinued, but this at the same time means that the frequency as a competitive parameter of the railway's, is deteriorating

The railway companies in the former USSR countries do not make the situation easier for each other either. The rates of the transfrontier freight services are calculated in SFr, are paid in local currency, but are settled in USD

For Uzbekistan this poses specific problems, as the railway lines are not built in consideration of the present borders This means that domestic transports in a number of relations become international transports with consequences for transport speed and monetary conditions. Among other things to eliminate these inconveniences proposals have been worked out for the building of 4 new railway lines with a total length of 709 kilometers

All in all it is a difficult competitive position, where the railways in many areas are captured in a vicious circle, which necessarily has to be broken, if the railways are to survive

2.1.3 The organisation of the railways

As mentioned above the railway companies are young, independent companies.

This is not reflected however, in the way the railway companies are organised

In general the railway companies are heavy, production oriented organisations, like we also knew them in Europe many years ago It has not been possible to substantiate the influence from actual commercial

organisational units. It is the Traffic Departments which are determining and it is here that supply, systems, quality, frequency and other competition parameters are determined.

It applies for Kazakhstan that the railways in the country are geographically divided into 3 independent railway companies. It is indeed a very large country, but it is a question of whether it would be a great advantage, if the 3 companies were merged into one company and that the large geographical distances were handled otherwise in the organisation.

It can clearly be seen from the chart that the organisation is production oriented.

At the visit in Uzbekistan it was confirmed that the Department of Traffic Services holds substantial power and influence. About 200 stations and 4.500 employees belong under Traffic Services. Here the assessment of supply is made by evaluation of the current plans and forecasts for the coming period. In connection with the timetable all other plans in connection with this are prepared for the decentralised part of the organisation. Finally it is Traffic Services which through the centrally located Operations Centre manages and controls the traffic and its implementation.

A very centralised system which seems adjusted to the size of the railway network and to the current traffic.

Railway Council

Russia and the now independent states from the FSU have set up a Railway Council with headquarters and secretariat located in Moscow. Ministerial representatives participate in the 2 yearly general meetings held by turns in the different member countries. Every day each individual railway company can draw on the expertise of the secretariat. In the Railway Council rules and guidelines for the traffic are determined, timetables and fares are matched and the "wagon-pool" is being administered.

It seems that by setting up this Railway Council, all countries are maintained in the same systems etc. as applied before the breaking up of the USSR. This of course gives advantages in relation to the infrastructure, the traffic regulation rules, the safety rules, etc., where a large degree of interoperability between the countries is secured.

For the traffic systems, the train systems, the timetables etc., the Railway Council seems to be a disadvantage, however.

Things continue as usual. Nothing indicates a renewal of the railways from this side. The only difference compared to previously is that at present no money for administration, operation, maintenance, renewal and expansion of the railways are granted from Moscow, which was previously the case in the FSU. This is now the task of each individual government.

As conclusion

It means that railways receive objectives for public services from their governments, but do not recieve compensated subsidies. Therefore, they are not able to define their owin obkectives as they should do in an oriented market economy.

2.1.4 The train systems

The train systems have not changed since independence and there is a certain degree of re-use of timetables from the 1980ies.

Thus traffic is to a large extent still oriented towards Russia and Moscow.

Concerning the passenger traffic, there are few departures with very large trains, very long-lasting stops at stations, frequent switching of locomotive and long travelling times. A system which most European countries left behind in the 1960ies and 1970ies.

In connection with the recession, quite a number of passenger trains have been removed and others are only running a few times a week. This means a lower frequency in the individual relations and a very long waiting time where a change of trains is necessary.

In summary it must be established that the passenger trains in all competition parameters do not show themselves very favourable. As the competing means of conveyance are extended and affluence - and thus also car accessibility - in the countries is increased, it must be expected that the train product - if it is not radically changed - will be the first thing to be rejected. Fewer and fewer people will go by train and the railway s reason for existing will cease to exist.

The freight traffic is characterised by only a few complete trains. This means that by far the most freight trains drive from marshalling yard to marshalling yard, where a sorting and new composition is taking place. There are furthermore frequent switching of locomotives.

All in all, transportation times are very long just as production costs become very high.

In connection with the sharply decreasing volumes of transport, the train size is sought to be maintained as close to the maximum as possible (50-60 wagons, a train length of about 1.500 metres). This means that a large number of freight trains are discontinued, resulting in a lower frequency in the individual relations.

Ascribed to the disability of the railway in the door-to-door system, also here it must be established that the system does not in itself present any major advantages for the purchasers of transportation. The advantage which might be left vanishes if the transport price of railway carriage is higher than the price of van carriage.

2.1.5 Efficiency and productivity

Compared to Europe, efficiency and productivity is substantially lower both regarding the rolling stock and staff resources.

A highly contributory cause for this is the system used in both Kazakhstan and Uzbekistan, according to which the locomotive and the team of engine driver/assistant is a fixed, collective entity, which always drives together. This means that the switching of locomotive must always be made on the basis of the rules on working hours of the engine drivers/assistants. Even though a locomotive is usually connected with several teams, the productivity for the motive power fleet must still be considered very low (250-350 km per 24 hours).

Locomotives driving passenger trains and freight trains are always worked by 2 employees (engine driver and assistant), whereas the shunting locomotives are one-man operated.

Locomotives with their teams are either driving passenger trains or freight trains and the individual locomotive drives the same trains every day.

As can be understood, the system is fixed and totally inflexible, and there is no doubt that this production element is absolutely decisive for how the timetable is planned and thus for the supply of products which is to attract customers.

The fact that the railway companies have chosen this form of production must be seen in the light of the locomotives being attended to and taken care of in a good and efficient way, when the locomotive is owned by a few engine drivers/assistants. This advantage can ultimately not justify the small effectively and low productivity of a large capital investment.

The productivity for the passenger coach stock is higher than for the motive power, whereas it is lower for the goods wagon stock. It has not been possible to obtain any information on the reloading frequency for goods wagons, which gives a more true picture of the efficiency measured against capital investment.

In the way both passenger trains and freight trains are produced. there is a substantial use of personnel. A passenger train with one restaurant car and 14 couched carriages and sleeping cars will for example be staffed with about 20 members of personnel. In connection with freight trains. the use of many personnel resources are required both at marshalling yards and furthermore when shunting.

Finally the speed reductions as a consequence of the inadequate maintenance of the infrastructure means that generally there will be less effectively and lower productivity than otherwise possible

2.1.6 Summary

As it appears from the above the railways are in a very difficult situation. The situation is not essentially different from the one the railways in Europe have been through. however. and which they in some areas are still in

Whereas the counteroffensive of the railways in Europe has been made at a relatively late stage in the sharpened competitive position from other means of transportation. the situation in Central Asia is more favourable seen from the viewpoint of the railways. By presently implementing the necessary changes. the railways will be at the leading edge of developments and will thus be able to comply with the sharpened competitive position. which arises concurrently with the reducing and ceasing of the recession and the increasing prosperity of the countries. In this context it should not be forgotten that with the many projects for extension of the road systems there will be a favouritism of both personal traffic and of van traffic.

In the following chapter. some of the actions which should be carried out to bring the railways at the leading edge of developments are described.

2.2 Suggestions to changes

2.2.1 Competition on equal terms

In a liberalised transport system it is necessary that the individual means of transportation may compete on equal terms. This means among other things that the access to the infrastructure and payment for using the infrastructure must be identical to all.

As is also the case in Europe. the railway companies are far more burdened by costs for and investments in management. operation. maintenance. renewal and extpansion of the infrastructure than other means of transportation.

In the EU with the Council Directive on development of the Community s railways (91/440/EEC) of 29th July 1991 a decision has among other things been made that the railway companies are to be secured a status as independent companies. which effectively. competitively and businesswise will be able to operate on the transport market. The directive furthermore prescribes that a separation must be made between management of the transport services and the infrastructure. so that there will be separate accounts and a separate administration. It is furthermore laid down that the member states should maintain the ordinary responsibility for the development of the infrastructure and that charges have to be paid for using the infrastructure.

This directive was at a later stage supplemented with the directives 95/18/EC on the granting of licences and 95/19/EU on the allocation of infrastructure capacity and the levy of infrastructure charges.

In August this year. the EU's commissioner for transportation has issued a white paper. which among other things deals with the separation of the operating companies and the infrastructure companies.

After the decision of the directives, a number of railway companies have chosen to hive off the railway infrastructure into a separate company, which can work in line with similar companies for road, aviation, shipping etc Other railway companies have chosen to keep the infrastructure company with its own accounts in the corporate railway company

Regardless of form of organisation, the operating companies, as also applies to roads, airports, etc., must pay for using the infrastructure which is also put at the disposal of other operating companies that might wish to use them

The model chosen in the EU can be applied in Central Asia, but other models may also be a possibility.

A model should under all circumstances be chosen and implemented, so that all railways in the coming years may meet their competitors on equal terms

2.2.2 The organisation of the railway companies

The current organisation that is characterised by being entirely production and traffic oriented should be changed into modern commercial companies with the primary object of meeting the needs and requests of the transport buyers

To as wide an extent as possible, the new organisation should be independent of political and ministerial interests so that all actions may be 100% market oriented. A corporate form like a limited company may prove appropriate

It is furthermore of great significance that the organisation is made with as few levels as possible to maintain efficiency

2.3 Change of train systems

2.3.1 Passenger service

Both the domestic and the international passenger traffic is characterised by a train system with very few departures but with very long trains

Similar train systems were known in Europe many years ago, but except from a few night train services, the train concepts in Europe have through a number of years been altered dramatically, and are now characterised by efficient Intercity Services, where light train sets with a high frequency, short travelling times and high comfort have successfully entered into competition with other means of transportation. Had this change not been made, Europe would presumably have seen the same development as in North America where the passenger traffic by railway for a number of years was almost outperformed.

With the new train concepts, it has furthermore been possible to increase efficiency and productivity quite considerably so that with less expenses than in the old system, a high-frequency, comfortable train system can be supplied

As described earlier, the railways in Central Asia are presently trapped in a vicious circle, where trains in the already low-frequent train system are being discontinued in order to reduce costs. With the cost structure in production that characterises railways, it is doubtful whether the effect of discontinuing trains is just roughly commensurate with the reductions in the products supplied, which become less attractive resulting in fewer passengers

The way out of the vicious circle should in that case be larger production which means more trains for a constantly falling level of expenses

And exactly the frequency in the train systems has in Europe shown to be a competitive parameter of extraordinarily great importance

The same applies to the comfort parameter The present comfort level in the train systems in Central Asia will not be competitive in the future and if this is not changed, only "compulsory" customers will make use of trains in future Concurrently with an increasing affluence, with an increasing number of private cars and where travelling by plane will be even more common, the number of "compulsory" customers and thus also the number of passengers in the trains will be further and further reduced. The vicious circle is fuelled.

If the railway is to be competitive, the trains must offer a comfort level like in aeroplanes or like the "front seat in a new Lada"

Travelling time should be mentioned as the third essential competition parameter. The railways in Central Asia have decided on a maximum speed for passenger trains at 100 km/h. In the long run, this speed should be increased When using light train sets, it will presumably be possible to increase the speed to 120 km/h or maybe to 140 km/h without changes or with minor changes in the infrastructure This has proven possible in Europe In connection with the travelling time, it is of utmost importance that the stopping patterns of the trains are carefully evaluated and that the stopping time at the stations is minimised to a few minutes.

The international traffic is characterised by the fact that trains are almost only driving to/from Russia (Moscow) Very few - if any - trains drive between the countries in the TRACECA-corridor The need is perhaps small but the airline companies have set up routes, however, that are regularly served. It should be estimated whether it would be commercially attractive to establish direct railway connections with a new train concept for example between Almaty and Tashkent

It can be problematic in the short run to base a change of the train systems on a necessary acquisition of - and thereby investment in - new stock by way of train sets

Experience from Europe shows that in a transitional period, the existing fleet of rolling stock may be successfully used Like for instance in Denmark where the Intercity traffic was started with the use of existing locomotives and passenger coaches, which for that purpose as to interior and seats etc were renovated and renewed, so that comfort corresponded the level in new stock. In Denmark this stock was used with great success for a period of 10 years, during which a phasing out took place concurrently with the supply of new train sets

2.3.2 Freight service

Earlier in this report, suggestions were given in connection with the international freight service in the TRACECA-corridor and thus also for freight service to/from Europe and China.

For the international freight service to/from Russia, a train system should be established, where complete trains in the relations where this is possible drive to/from one single station In the relations where it is not possible to drive complete train wagons from/to the domestic freight train system should be collected and distributed at one single station

Similarly the domestic freight train system should be altered, so that direct complete trains should drive without stopping at marshalling yards, and in principle drive with the same locomotive and without shunting between two terminals (stations) Such a change of the train system would with the current recession presumably mean that the present size of trains with 50-60 wagons would be reduced With an efficient conveying system, the costs of driving small trains will be of a significantly smaller extent than the obtainable cuts at the terminals Furthermore, the speed of transport will be able to be increased considerably

The current system for transport of goods is characterised by very high terminal expenses partly for the marshalling yards but also in connection with the collection and distribution of wagons, where many shunting engines are used

3. Rolling stock characteristics

3.1 Locomotives

3.1.1 Main line diesel locomotives

Diesel/Electric locomotives - Line						
Type of locomotive	Start of the serie	Axle arrangement	Axle load	Power	Maximum Speed	Taction ability
2TE 10M	1973	$2(3_0\text{-}3_0)$	23 t	2 x 2200 cv	100 km/h	3 600 t
3TE 10M	1973	$3(3_0\text{-}3_0)$	23 t	2 x 2200 cv	100 km/h	5 200 t
2TE 10V	1975	$2(3_0\text{-}3_0)$	23 t	2 x 3000 cv	100 km/h	3 600 t
2TE 10D TS TST	1963	$2(3_0\text{-}3_0)$	21 6 t	2 x 3000 cv	100 km/h	3 600 t
TE3	1963	$2(3_0\text{-}3_0)$	21 t	2 x 2000 cv	100 km/h	
TEP 70	1973	$3_0\text{-}3_0$	21.5 t	4000 cv	160 km/h	

Weight of 2T3 10A 260 6 tonnes
Weight of each of the other types of locos 276 0 tonnes
Lenght of loco 35 metres

Main diesel locomotives two stroke, double piston Shunting four stroke All bogie -loc (3 axles)
Consumption
Main locomotives 60 kg diesel per 10 000 ton km
Shunting 20 kg diesel per hour in operation

3.1.2 AC electric locomotives

27 kV 50 Hz Electric locomotives						
Type of locomotive	Start of the serie	Axle arrangement	Axle load	Power	Maximum Speed	Taction ability
VL 80C	1980	$2(2_0-2_0)$	24 t	6520 kW	110 km/h	4 000 t
VL 80 T	1967	$2(2_0-2_0)$	23 t	6320 kW	110 km/h	4 000 t
VL 60 K	1967	3_0-3_0	23 t	4590 kW	100 km/h	1 500 t
ER9E				3600 kW	130 km/h	

3.1.3 DC electric locomotives

3 kV DC Electric locomotives						
Type of locomotive	Start of the serie	Axle arrangement	Axle load	Power	Maximum Speed	Taction ability
VL 8	1957	$2(2_0-2_0)$		3200 kW	80 km/h	
VL 10	1967	$2(2_0-2_0)$		5120 kW	80 km/h	
VL 11	1967	$2(2_0-2_0)$		5120 kW	80 km/h	

3.1.4 Diesel shunting locomotives

Diesel/ Electric locomotives - Shunting						
Type of locomotive	Start of the serie	Axle arrangement	Axle load	Power	Maximum Speed	Taction ability
TSME3	1964	3_0-3_0	20 2 t	1350 cv	90 km/h	1 200 t
TEM1	1956	3_0-3_0	20 0 t	1000 cv	100 km/h	1 200 t
TEM2$_{D,TS,TSM}$	1960	3_0-3_0	21.0 t	1200 cv	100 km/h	1 200 t

Both types of shunters are 2 x three-axled
TM3-2 1200 HP
4M3-3 1000 HP

3.2 Passenger coaches

They have two main types of wagons. sitting and sleeping wagons. The origin of sleeping wagons is Germany (Amendorff) and sitting wagons Russia (Tver).

Type	Reference	Dimensions (m)	Weight (t)	Couchettes / Seats	Speed limit (km/h)
Suburban cars	ЦМобл	23 6 x 3 1 x 4 4	49	68 / -	160
Couchette cars	ЦМО	23.6 x 3.1 x 4 4	52	54 / 81	160
Sleeping cars	ЦМК	23.6 x 3.1 x 4.4	52	36, 38 / -	160
Comfort Sleeping cars	СВ	23 6 x 3 1 x 4 4	64 58	16 / - 24 / -	160
Comfort Sleeping cars	РИЦ	26 1 x 2 9 x 4 2	55	33 / -	200
Sleeping cars	23СБО				
Post & lugage cars	ЦМп:б	23 6 x 3 1 x 4 4	47		160
Restaurant cars	ЦМр	23 6 x 3 1 x 4 4	54		160

The **couchette cars or standard cars, and suburban cars** were fabricated in Russia. They have incandescence and fluorescent lights supplied by generators and bateries located in the cars. The heater are mainly hot water circuit supplied by a coal boilers or in some of the most recient, the heating is electric. They are fitted with double glass windows and forced ventilaiton. The couchette cars have opened compartiments

The **CB comfort sleeping cars** have the same characterisiics as the previous one. they have air conditionning. They are 2 place compartment

The **ЦМК sleeping cars** were fabricated in East Germany. they standard comfort and air conditionning. They are 4 place compartment

The **РИЦ sleeping cars** were also fabricated in East Germany. they are fitted with electric heaters and air conditionning

The other types have the same characteristics as the standard cars

3.3 Freight wagons

Type	Ref	No. of axles	Load limit	tare	Usable space	Time life
Covered wagons	PR	4	60 - 68 t	22 - 26.5 t	90 - 120 m^3	32 years
Low sided wagons	PV	4	60 - 69 t	21 - 25.5 t	50 - 76 m^2	
		6	94 t	32.4 t	104 m^2	32 years
		8	125 t	43.6 t	140 m^2	
Flat wagons	PL	4	60 - 70 t	20 - 22.7 t	37 m^2	32 years
Tank wagons	TSS	4	50 - 60 t	21.8 - 25.6 t	50 - 72 m^3	32 years
		8	120 t	48.8 t	140 m^3	
Refrigerator wagons	XX	4	30 - 49 t	28.5 - 32.5 t	54 - 82 m^3	25 years
Others						

Among the « others » are included : car-carriers and wagons carrying :containers, cattle, grains, ciment

All wagons have bogies (two wheel-sets).
Speed limit of all types of wagons : 120 km/h

Type of wagon	Purpose (mainly)
KR, closed	cotton
PL, platform	Stone
PV, open	Coal
TsS, Tank	Oil and chemicals
PR, closed	Special transportation , incl container wagons
XX, closed	Refrigerator, transport of vegetables

4. Maintenance procedures

The standard procedures for preventive maintenance of all kind of rolling stock is basically carried out at three levels

i) TO 1 TO 2 and TO 3 Technical inspections at stations and terminals

ii) TR 1, TR 2, and TR 3 Running maintenance at depots

iii) KR 1 and KR 2 Major overhaul/Capital Repair

4.1 Locomotives

Light maintenance for the locomotives

Type	Tasks	Periodicity
Inspection		
TO 1	Inspection	Loco driver
TO 2	Inspection and lubrication	In depot over pit
TO3	Inspection and lubrication Check of diesel engine, motor brushes, electrical brake	In depot over pit
Light maintenance		
TR1	Running maintenance Inspection of components, lubrication of all moving parts As TO3 plus oil all parts, clean all motors by pressured air check of fuel injection	In depot over pit
TR2	Running maintenance Check of bogies and gears	In depot (in depot fitted)
TR 3	Running maintenance Check wheels and motors	In depot (in depot fitted)
Overhaul maintenance		
KR 1	Capital overhaul Check of insulation Exchange of cables Diesel engine replaced	In repair plant
KR 2	Capital overhaul Complete dismantle of loco Exchange of worn out parts.	In repair plant

In the following table are shown the intervals in kilometres or time between preventive maintenance/capital repair for the fleet of locomotives

TYPE	TO 3	TR 1	TR 2	TR 3	KR 1	KR 2
VL 8 **VL-11** **VL-23**	11.100	22.000	165.000	330.000	650.000	2 mill. km or max 12 years
TE 10	7.200	29.000	115.000	210.000	680.000	1.360 mill. km or max. 9 years
TEZ	7.500	30.000	120.000	210.000	720.000	1.440 mill. km or max.10 years
M 62	8.000	40.000	120.000	240.000	720.000	1.440 mill. km or max 9 years
CMEZ **TEM 1** **TEM 2**	30 days	7.5 months	15 months	30 months	7.5 years	15 years
ER 2 **CR 3**	5 days	50 days	150.000 km	300.000 km	600.000 km	1.800 mill. km 1.200 mill. km

Average overhaul periods and duration of maintenance and repair of diesel locomotives

Type & series of diesel locomotives	Average overhaul periods	not more thou km not more days. (months. years)				
	TO-3	TR-1	TR-2	TR-3	KR-1	KR-2
1 Freight & passanger locomotives with electric traction TE 10	7.2 17 days	29.0 2.3 months	115.0 9.2 months	210.0 18 months	680.0 4.5 years	1360.0 1 year
TE3 3TE3 ТЭ3 3ТЭ3	7.5 18 days	30.0 2.5 months	120.0 10 months	210.0 18 months	720.0 5 years	1440.0 10 years
ТЕР70 ТЭП70	8.0 18 days	40.0 3 months	200.0 15 months	400.0 30 months	-	-
2 Shunting locomotives TEM1 TEM2 CHEM3 ТЭМ1 ТЭМ2 ЧЭМ3	30 days	7.5 months	15 months	30 months	7.5 years	15 years

Type & series of diesel locomotives	Average overhaul periods	not more, thou km not more days, (months, years)				
	TO-3	TR-1	TR-2	TR-3	KR-1	KR-2
Standard time of technical maintenance & routine repair of diesel locomotives	TO - 3 (hrs)	TR-1 (hrs)	TR-2 (days)	TR-3 (days)		
TE 10 ТЭ 10	10	40	5	6		
TE 3 ТЭ 3	8	36	4.5	4.5		

Average overhaul periods and duration of maintenance and repair of elecrice locomotives

Type & series of rolling stock	**Distance run between overhauls, thou km**					
	TO-3	TR-1	TR-2	TR-3	KR-1	KR-2
1.Electric locomotives						
VL 60 (all Indices)		14	190	380	760	2300
VL 80 (all indices)		14	200	400	800	2400
2. Shunting electric locomotives (bringing out, transferring)	30 days	2 months	1 5 years	3 years	6 years	12 years
3. Electric trains ER9 (all indices)	5 days	50 days	150	300	600(not more than 4 years)	1800
Standard idle time	TO-3	TR-1	TR-2	TR-3		
Electric locomotives	6 hours	15 hours	1 5 days	3 5 days		
Electric sections	4 hours	9 hours	2 days	7 2 days		

4.2 Passenger coaches

Type of inspection	Periodicity	Tasks
TO-1	before operation	check
TO-2	6 months	Technical service. change of couplings control of brake systems. lubrication
TO-3	12 months	Depot maintenance lift of coach Maintenance of: bogies. bearings. brake systems check of all passenger related items
KR-1	5 years	Major overhaul
KR-2	20 years	Capital repair

4.3 Freight wagons

Type of maintenance	Frequency
TO-1	Inspection of wagons before loading
TO-2	Inspection of wagons after loading
TO-3	Inspection after 6 months. operation status
TR-1	Inspection after 6 months. on special order from workshop (rehab)
TR-2	1 year. workshop maintenance
KR-1	5 years. main maintenance
KR-2	10 years. main maintenance

The in-coming train inspection relies very much on a detector. placed 3 to 4 kms before the station
The detector is checking on both sides of the train if a wagon has a hot box and it can even detect if some of the brake gear is dragging below a wagon
If a hot box occurs. a signal is automatically sent to the station indicating which wagon is defective

Yearly preventive maintenance is not carried out the first three years after a new delivery of a wagon. and after a majot overhaul the wagon is in traffic for two years before the yearly maintenance takes place

- After 12 years a major overhaul is carried out
(8 years for tankers carrying acids)

The planned inspection system consist of:

Type of inspection/ maintenance	Frequents
TO-1	Inspection of wagons before loading
TO-2	Inspection of wagons after loading
TO-3	Inspection after 6 months. operation status only for refrigerator wagons
TR-1	Inspection on special order from workshop (rehabilitation before use)
DR	1 year. workshop maintenance
KR-1	5 years main maintenance. refrigerator wagons only
KR-2	8 years. main maintenance

Chapter 2 KAZAKHSTAN Railways

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1. Overall situation

In the region, KAZAKHSTAN is the only country of the TRACECA corridor to have connection to RUSSIA, to CHINA and to the Caspian Sea, which brings to that country a great position to the others (UZBEKISTAN, KYRGHYZSTAN, TADJIKISTAN and TURKMENISTAN) who should cross KAZAKHSTAN to reach RUSSIA, CHINA or the Caspian Sea (except UZBEKISTAN)

That long border with RUSSIA, its economic position as partner and provider to RUSSIA and its strategic position vis a vis the other countries, explain, among other things, the good relationships between the two countries in railways management

Being the largest country of the TRACECA region but of the lowest density, the railways should play a major role in the economy of the country but also of the region. However, that low density involves a higher weight to infrastructure maintenance than the other countries. The road network suffers the same difficulty for its maintenance, which should reinforce the position of the railways.

The breakdown of the FSU, implied the same deficiencies than the other countries : spare parts, overhaul, maintenance, management. As most of the other, KAZAKHSTAN should be financially self sufficient, for which it was not prepared

The KAZAKHSTAN Railways is the main network and owns the most important fleet of rolling stock of all Central Asia region. Its own fleet is as large as the total of the four others countries who face the same difficulties

The Railways Department has already ordered to the Railways Institute several studies in order to find solutions to that situation. Most of the studies have not been completed, the feasibility of the alternatives proposed have to be proven

1.1 Network

The three networks of KAZAKHSTAN are directly under the responsibility of the ministry of Transport and Communication. The three networks are financially independent and do not receive any subsidies from the ministry. For that reason they have a real autonomy from this ministry who lost power to manage some of them

1.1.1 Description of the network

The length of the whole network is 13 500 km of which

- Double tracks	3 540 Km	} Electrified : 3 300 Km
- Partially double tracks	1 150 Km	
- Single tracks	8 820 Km	

The three independent networks are

- Almaty network
- Tselinaia network
- West KAZAKHSTAN network

93 main stations and about 900 stops which enable train crossing

The whole network is connected to RUSSIA KYRGHYZSTAN, and UZBEKISTAN in several places, to China in one point, and to the Caspian Sea

The network is mainly constituted by a North - South line, between Akmola and Shu. East - West lines are connected to this backbone line To the North the line is divided into two East - West branches linking Akmola to Moscow. To the South at Shu, the line receives the East and North East branch, coming from Almaty and turns West to Shimkent and serves Tashkent and the TRACECA corridor

The main line links : Akmola - Shu - Shimkek- Chengeldy (UZBEKISTAN border close to Tashkent). 1658 km an alternative line links the Russian border at Two branches serve the Russian border : Tobol - Akmola 664 km and Presnoogorkaya - Kokchetav - Akmola. 632 km

Those main lines are double tracks and electrified in most of their length

The Chengeldy (UZBEKISTAN border close to Tashkent)- Arys - Kangadach - Aktoibinsk. 1503 km. constitutes the major East West backbone of the country The Kandagach junction ties the Makat - Aktao branch (1275 km). the Aksaraiskaya branch (843 km)

The Shu - Almaty branch. 311 km. is partially fitted with double track

A single track links Almaty - Aktogay and to China border. 861 km. The China border is also connected to the main North South line at Mointy. 828 km

1.1.2 Conditions of the networks

The lines which are electrified are in pretty good conditions, and they are fitted with double tracks. The line connected Almaty and China in the Trans Asia line and the main line to Moscow are also in pretty good conditions and partially fitted with double tracks, however the other lines face problems of maintenance and the speed limit should be reduces in many places

It should be noted that the TRACECA line does not follow the Trans Asia corridor and the country will have difficulties to maintain properly both corridors

It should also be pointed out that the main link to Moscow is not electrified. Obviously the electrified line follow the corridor of minerals resources (Karaganda, then the line Pavlodar, Ekibastuz, Akmola)

On the main line, the stations or shunting areas are separated by an average of 15 km. Each of those stations are not always a passenger station or stop but each of them allow trains cross together, they are fitted with shunting tracks, allowing crossing of trains of 850 m long

1.2 Traffic

Having been one of the most important traffic in the world, the traffic in KAZAKHSTAN is still as high as European most important traffics

The freight traffic has drastically decreased during last past seven years, the passenger traffic has been kept constant during the same period Nevertheless, the financial conditions of the railways do not allow them to buy the spare parts required to maintain the passenger coaches and the coaches are often overloaded

1.2.1 Freight traffic

Formally very high. the traffic is still high since the quantity is still over 200 million tonnes (higher than the French traffic. and the production of services in tonne x Km is even more higher than the European and other CIS figures due to dimensions of the country.

Year	Mln tonnes	Bln tonne x km
1980	308	354
1985	337	382
1990	345	407
1991	328	374
1992	289	286
1993	218	190
FRANCE	120	45
GERMANY	291	65

Freight traffic per main categories of product

The transit traffic was not taken into consideration in the preceding table. it represents now 25% of the traffic

The coal from Karaganda and Exinbastuz. the construction materials which are evenly distributed in the country and the minerals represent more than 50°₀ of the national traffic.

The transit traffic represents 25°₀ of the traffic

	1989	**% of total 89**	**1992**	**% of total 89**
Coal	128.90	24.77%	117.70	31.38%
Oil products	25.50	4.90%	19.90	5.31%
Metals	7.00	1.35%	6.00	1.60%
Minerals	47.60	9.15%	37.10	9.89%
Materials for construction	72.50	13.93%	53.20	14.18%
Chemicals	17.90	3.44%	9.50	2.53%
Grains	7.80	1.50%	9.00	2.40%
Others	36.10	6.94%	23.80	6.34%
Transit traffic	177.10	34.03%	98.90	26.37%
Total	**520.40**	**100.00%**	**375.10**	**100.00%**

The average trip of wagon is 8.9 days

1.2.2 Passenger traffic

It is rather constant even after the breakdown of the FSU. It is rather heavy since it represents almost 3 times the population of the country (5 times in France)

Year	Min pass	Bln pass x km
1980	37.1	14.8
1985	34.1	15.8
1990	42.6	19.7
1991	40.0	19.4
1992	39.7	19.7
1993	41.2	20.5
GERMANY	1420	57
FRANCE	814	58
Paris area	553	10

Daily trips of passenger trains :

- on electrified lines : 546 km
- on diesel lines : 527 km

The load ratio of passenger trains is >1 due to the lack of coaches. (the passenger traffic has been constant for the 10 past years)

The average speed is limited in some areas due to the conditions of the track. Even where the conditions of the track are fair, the average speed is low, less than 50 kph (35 kph for the « rapid train » between Almaty - Shimkent) due to :

- the rules of operation :exchange of locomotives, inspection,...
- the single track on 70% of the networks, required idle time for crossing of trains running in opposite directions

1.3 Operation

1.3.1 Main characteristics

The time tables, fare structures and coordination are under the « advice » of the Common Council based in Moscow. The time table is still referenced to Moscow local time. For passenger services, it has not changed significantly since the breakdown of the FSU.

The average speed is very low, less than 50 kph, due to :

- For the passenger trains : the too much stops for the long distance trains, there are some local trains (Almaty - Akmola, Almaty - Shimkent, ...), but the international trains (Almaty - Moscow) have stop in many stations served by the local trains ;
- For the freight trains : too much stops in marshalling yards and crossing stations ;
- For the passenger trains : the technical limits of the rolling stock, only one type of electric locomotive (VL80) could run at more than 100 kph, the passenger coaches could run at 160 kph in standard condition.

- For both passenger and freight trains, the track conditions could certainly not allow a higher speed than 100 kph

1.3.2 Integrated management between train operation and maintenance

Two or three crews of two people (driver and assistant) are attached to one line locomotive which is generally constituted by a twin vehicles. Each team works 8 hours which could be increased up to 12 hours and have a two days off following 2 days on duty. They should have a medical check before driving. The team (drives - locomotive) should come back to their attached depot after a maximum run of 300 km.

The crews assist in the inspection and maintenance of « their » locomotive, they ensure the Quality Control, obviously that organisation simplifies the management and constitutes the guarantee of a certain quality.

That organisation melted the train operation function to the maintenance functions which is certainly efficient in a technical point of view but certainly not oriented to the quality of the service offered to customers. Moreover the trains are fitted with security control tape records, but the tapes are checked in the depot which allows kindness and relationships between inspectors and drivers.

This management is consuming in time and money. The use of locomotives is not optimised

- even though a crew can take place of a preceding crew, the locomotives could be operated more than 24 hours over 48 hours, they are used at about 60% of their capacity, therefore more locomotives are required to carry out the same service :

- the drivers should not drive 12 hours but 6 to 8 hours but more efficiently ; in fact they do not drive 12 hours but a 12 hours shift includes idle times (at least at the terminal station, the return way should not follow immediately the way on :

- the management of operation is not smooth : when drivers are not available, the locomotives may not serve a train which requires a traction power :

- since the drivers would certainly not take any risks of failures, they will imply an over maintenance.

In the mean time, the operation management and the maintenance management are easier :

- the drivers are fully responsible for the service they should cover, the conditions of « their rolling stock », the running time

- the maintenance management can rely on the drivers who will not take any risks of breakdown and who will work in close cooperation with the depot

To change that organisation implies to :

- substitute a relevant Quality Control service :

- implement an efficient Management Information System which will ensure the follow up of the situation ;

- responsibilities the train operation management.

2. Rolling stock

2.1 Locomotives

Since 25% of the network is electrified, the fleet of locomotives is constituted by electric and diesel locomotives, the fleet is larger than required for the operation and some locomotives are stored. Due to the lack of spare parts, the stored locomotives are cannibalised..

For that reason, it is difficult to get a reliable count of out of order locomotives.

The locomotives belong to the ministry and not to the railway network who cannot sell the rolling stock to increase its own budget. In that conditions, the networks should maintain those locomotives to their attachment in order to justify budget for spare parts, personnel, and maintenance running costs.

Nevertheless, for strategic reasons (security, maintainability,...) some of these idle locomotives are thoroughly stored. There not are attached to any network.

Due to the different characteristics of the trains to be hauled, locomotives for passenger trains are different than locomotives for freight trains, the passenger locomotives are less powerful than the freight locomotives, but they should be faster, which is still the case for many railways in the world. But, again, due to lack of spare parts and the evolution of traffic, the passenger locomotives are missing while freight locomotives are available due to the decrease of freight traffic. So, the freight locomotives are used to haul passenger trains, which is not efficient and costly. The locomotives designed for the passenger trains are mainly : for the diesel locomotives TEL60, TEP60, TEP70, and for the electric locomotives : VL60 et VL80.

Generally speaking the locomotives are very heavy and designed with an old technology. Due to their weight, most of them have 3 axles bogies, even for shunting locomotives. In operation, passenger and freight locomotives are coupled in twin units.

Purchase years of the locomotives of the Almaty's network

Diesel locomotives		
Line locomotives	2TE 10L	1970 - 1976
	2TE 10V	1976 - 1981
	3TE 10M	1980 - 1985
	2TE 10M	1982 - 1987
Shunting locomotives	T 7M	1966 - 1982
	TS 7M3	1987
Electric locomotives		
	VL VOC	1986 - 1993

Fleet of locomotives (year 1995)

The TS indices have been given to the Check production

Electric locomotives	**Diesel locomotives**			**Number of vehicles**
	Total	Line	Shunting	
738.5	2327.5	1594.5	733	3060

Age of the fleet

Type of locomotives	**less than 5**	**less than 10**	**less than 15**	**more than 15**	**more than 20**
Line - Diesel	125	360	509	601	
Shunting Diesel		140	227	366	
Electric		290.5	243	100	105
TOTAL	125	790.5	979	1067	105

Note : In those tables the locomotives are considered as multiplied units, not as separated vehicles.

For the whole network, no locomotives are available for passenger trains, therefore, diesel and electric locomotives for freight trains are used for passenger trains.

60°o of the fleet is less than 15 years old

Uses of shunting locomotives

- shunting in stations and yards
- shunting in marshalling yards and loading and unloading freight stations
- transfer from loading freight stations to marshalling yards. for instance the coal from KARAGANDA mines to the marshalling yard of KARAGANDA
- on the TSELINAIA network. 12 electric locomotives are used for the transfer of wagons from the loading station to the marshalling yard

2.2 Fleet of passenger coaches

Breakdown per age of the vehicles

Type of vehicle	Ref	before 1961	before 1971	before 1981	before 1986	before 1991	after 1991	Total
Reserved Seat Cars		4	95	526	205	351	16	1197
Standard Sleeping Cars	TSMK	2	170	95	121	177	36	601
Comfort Sleeping Cars				7		10	3	20
Comfort Sleeping Cars				5	29			34
Comfort Sleeping Cars			3					3
Commuter Cars		25						25
Total		**6**	**293**	**633**	**366**	**538**	**55**	**1880**
Restaurants Cars			24	18	34	17	9	102
Others		37	131	27	2	4	2	203
Total		**43**	**448**	**678**	**402**	**559**	**66**	**2185**

50°o of the fleet are less than 15 years old

2.3 Wagon fleet

2.3.1 Characteristics of wagons

Type	No. of axles	Load limit	tare	Useful space	Total fleet
Covered wagons	4	60 - 68 t	22 - 26.5 t	90 - 120 m^3	17 820
Low sided wagons	4	60 - 69 t	21 - 25.5 t	50 - 76 m^2	39 510
	6	94 t	32.4 t	104 m^2	
	8	125 t	43.6 t	140 m^2	
Flat wagons	4	60 - 70 t	20 - 22.7 t	37 m^2	14 130
Tank wagons	4	50 - 60 t	21.8 - 25.6 t	50 - 72 m^3	11 570
	8	120 t	48.8 t	140 m^3	
Refrigerator wagons	4	30 - 49 t	28.5 - 32.5 t	54 - 82 m^3	2 240
Others					15 760
Total					**101 300**

Among the « others » are included : car-carriers and wagons carrying :containers, cattle, grains. cement

Speed limit of all types of wagons : 120 km/h

Average age of the fleet :

Built before 1961	9 100
Built between 1961 and 1981	57 100
Built after 1981	41 800
Total	**108 000**

40°o of the wagons are less than 15 years old

3. Maintenance

Every of the three networks has its own depots and workshops for the repairs and the light maintenance of their vehicles.

There is few cooperation between the networks. which plan to improve or implement new maintenance for their own production.

The overhauls are carried out in the following workshops :

- the diesel locomotives in RUSSIA and UZBEKISTAN .
- the electric locomotives in RUSSIA :
- the semi wagons at Akmola in KAZAKHSTAN. the other wagons in RUSSIA ;
- the passenger coaches in Almaty and in RUSSIA.

3.1 Locomotives

As stated in different reports, the run out of locomotives is mainly due to the lack of overhaul maintenance infrastructures in the country. The depots are numerous, but they do not have the spare parts to maintain properly the rolling stock.

For the time being, the locomotives repairs and overhauls are carried out in Russia, which is expensive and time consuming Furthermore, the services have to be paid in foreign currencies.

The depot are not fitted with the maintenance equipment and the personnel is not qualified to carry out the overhaul maintenance (KR).

42 depots are evenly distributed all over the country for the light maintenance of the locomotives. Among them, 7 are specialised for the electric locomotives. All of them are responsible for the maintenance of their own locomotives, the number of the attached locomotives is in relation to the size of the depot and its location Each of them are responsible for the drivers attached to those locomotives.

On main line the distance between depots is about 250 km, which is very high even for that technology, but this distribution is in relation to the maximum distance to be covered by the team driver / locomotive.

For the diesel locomotive, the tank of oil is filled up when go through a depot, therefore every 250 or 300 km

According to the equipment of the depots, they can carry out servicing TO3 and preventive maintenance TR1 TR2 or TR3 When the equipment does not enable a certain level of maintenance, the locomotive is driven to another depot. The locomotive department of the own network assigned the maintenance of the locomotives in the relevant depots

Procedures defined accurately the tasks to be performed in each level of preventive maintenance. Each depot has the responsibility to schedule the preventive maintenance of the locomotives in relation to the mileage or the time spent since the last cycle of maintenance.

The follow up of the maintenance of the locomotive is stored in a manual file in the assigned depot.

Almaty locomotive workshop

The workshop is in charge of the operation and the maintenance of 130 diesel locomotives of 2TE 10 (twin line locomotives) and TEM (shunting locomotives)

The workshop carried out the TO3, TR1 to TR3 maintenance.

The personnel is constituted by 1800 people among them 308 drivers and 270 driver assistants. The maintenance personnel works in two shifts, each shift is 12h during two following days and then 2 rest days.

Generally speaking, the depot should be improved :

- the working conditions could be improved the pavement should be cleaned and free for movement, the unused equipment should be stored properly for the security of personnel but also for the conditions of the equipment, the unusable equipment should be put out of the working space ;

- the security of personnel is not ensured

- the maintenance equipment and tooling are from an old technology, and they need maintenance, but they can be used efficiently

The projects :

Overhaul workshop for diesel locomotives at KAZALINSK

Overhaul workshop for electric locomotives at BOROVOYV

Overhaul workshop for shunting locomotives at AKMOLA

3.2 Wagons

The wagons should be maintained every year in the country where it is located when it reaches the periodicity. The date and location of the maintenance is paint on the wagon.

20 wagon depots are evenly distributed to carry out the light maintenance of wagons

Overall maintenance is done in specific workshop. There is only one of this workshop in KAZAKHSTAN. in Akmola. for the maintenance of the high sided open wagons.

In terminal stations, loading and unloading stations and in marshal yards. inspectors check the condition of the wagons and allow them to run

The projects

Capital repairs and overhaul of the tank wagons in Djambul

Capital repairs and overhaul of frigorific wagons in Shimkent

3.3 Passenger coaches

3 coach depots are specialised for the light maintenance of the passenger cars, they are located in Almaty. Akmola and Aktyubinsk.

The Almaty plant for main repairs of passenger cars is the only working plant of the Central Asian countries.

The Almaty passenger coach depot carries out maintenance of electric motors.

The project

Plant for construction of passenger coaches in Almaty

4. Annexes to this chapter

Chart of the railway organisation

Breakdown of locomotive depots with their own fleets

Volume of traffic freight per section (1989 to 1994)

Attachment of locomotives in the Almaty network as of 01.06.96

Приписной парк локомотивов Алматинской железной дороги на 01.06.96

Depot name Название депо	Diesel line locomotives Магистральные тепловозы							
	TOTAL Всего	VL80C ВЛ80С	3TE10M 3Т310М	2TE10M 2Т310М	2TE10V 2Т310В	2TE10L 2Т310Л	TE3 Т33	TE70 Т370
TURKESTAN Туркестан	58.9		1.4	2	2	-	53.5	-
ARYS Арысь	6	89.5	6	-	-	-	-	-
JAMBYL Жамбыл	62.2	30	38.7	5	16.5	2	-	-
ALMATY Алматы	75.6		2.1	31	9	33.5	-	-
SARY-OZEK Сары-Озек	38		-	3	35	-	-	-
MATAI Матай	31.9		1.4	18	7	5.5	-	-
AYAGUZ Аягуз	123.5		19	27	7	55.5	-	15
CHARSKAYA Чарская	38.2		1.7	8	28.5	-	-	-
SEMIPALATINSK Семипалатинск	-		-	-	-	-	-	-
ZASHCHITA Защита	43		-	13	6	24	-	-
CHU Чу	72.5	21	53	8	-	10.5	1	-
SARY-SHAGAN Сары-Шаган	-		-	-	-	-	-	-
TOTAL **Всего**	**549.8**	**140.5**	**123.3**	**115**	**111**	**131**	**54.5**	**15**

Attachment of locomotives in the Almaty network as of 01.06.96

Приписной парк локомотивов Алматинской железной дороги на 01.06.96

Depot name Название депо	Diesel shunting locomotives Маневровые тепловозы					
	TOTAL Всего	4ME3T 4МЭ3Т	TEM1 ТЭМ1	TEM2AUM ТЭМ2АУМ	TGK2 ТГК2	TEM2 ТЭМ2
TURKESTAN Туркестан	7	-	-	-	1	6
ARYS Арысь	11	7	-	4	-	-
JAMBYL Жамбыл	27	3	-	-	-	24
ALMATY Алматы	42	24	-	9	-	9
SARY-OZEK Сары-Озек	17	-	-	2	-	15
MATAI Матай	3	-	-	-	-	3
AYAGUZ Аягуз	10	-	-	-	-	10
CHARSKAYA Чарская	3	-	-	-	-	3
SEMIPALATINSK Семипалатинск	23	-	-	2	-	21
ZASHCHITA Защита	26	-	-	-	-	26
CHU Чу	9	-	-	2	-	7
SARY-SHAGAN Сары-Шаган	4	-	-	-		4
TOTAL Всего	**182**	**34**	-	**19**	**1**	**128**

Attachment of locomotives in the Almaty network as of 01.01.93

Приписной парк локомотивов Алма-Атинской железной дороги на 01.01.93.

Depot name Название депо	Diesel line locomotives Магистральные локомотивы							
	VL80C ВЛ80С	TOTAL Всего	3TE10M 3Т310М	2TE10M 2Т310М	2TE10V 2Т310В	2TE10L 2Т310Л	TE3 Т33	TEP70 ТЭП70
TURKESTAN Туркестан		61	-	-	-	-	61	
ARYS Арысь	129.5	19.2	14.2		1	4		
JAMBYL Жамбыл	6 5	97.2	60.2		28.5	8.5		
ALMATY Алматы		94.7	8.7	20	8.5	57.5		
SARY-OZEK Сары-Озек		39		4	35			
MATAI Матай		42	5	14	9	14		
AYAGUZ Аягуз		108.2	23.2	4		64	2	15
CHARSKAYA Чарская		38	2	6	29	1		
SEMIPALATINSK Семипалатинск		3					3	
ZASHCHITA Защита		55.5	10	5	4	34.5	2	
CHU Чу		71.4	61.4			2	2	
SARY-SHAGAN Сары-Шаган								

Attachment of locomotives in the Almaty network as of 01.01.93

Приписной парк локомотивов Алма-Атинской железной дороги на 01.01.93

Depot name Название депо	Diesel shunting locomotives Маневровые локомотивы				
	TOTAL Всего	4ME3 4МЭ3	TEM1 ТЭМ1	TEM2AU ТЭМ2АУ	TGK2 ТГК2
TURKESTAN Туркестан	8			6	2
ARYS Арысь	58	13		45	
JAMBYL Жамбыл	22	3	1	26	
ALMATY Алматы	40	26		14	
SARY-OZEK Сары-Озек	18			18	
MATAI Матай	2			2	
AYAGUZ Аягуз	7			7	
CHARSKAYA Чарская	3			3	
SEMIPALATINSK Семипалатинск	23			23	
ZASHCHITA Защита	28			28	
CHU Чу	11		1	10	
CARY-SHAGAN Сары-Шаган	4			4	

Attachment of locomotives in the West Kazakstan network as of 01.01.93

Приписной парк локомотивов Западно-Казахстанской железной дороги на 01.01.93

Depot name Название депо	Diesel line locomotives Магистральные тепловозы						
	TOTAL Всего	TE3 ТЭ3	2TE10L 2ТЭ10Л	2TE10V 2ТЭ10В	2TE10M 2ТЭ10М	2TE10U 2ТЭ10У	2TE10UT 2ТЭ10УТ
KZYL-ORDA Кзыл-Орда	78		11	40	16	11	
KAZALINSK Казалинск	31			5	26		
SAKSAULSKAYA Саксаульская	41		1	30	10		
CHIILI Чиили	11			10	1		
CHELKAR Челкар	53			24	29		
EMBA Эмба	69.5	3	1	45.5	10	4	6
KANDAGACH Кандагач	30	4		1	21	4	
AKTYUBINSK Актюбинск	80		38 5	11	26.5	1	3
SHUBAR-KUDUK Шубар-Кудук	56 5			27	23.5	6	
URALSK Уральск	69	1	15	28	20	5	
MAKAT Макат	89	2		13	67	7	
AKTAU Актау	30	11	19				
ATYRAU Атырау	61				53	8	
BEINEU Беинеу	33				21	11	

Attachment of locomotives in the West Kazakstan network as of 01.01.93

Приписной парк локомотивов Западно-Казахстанской железной дороги на 01.01.93

Depot name Название депо	Diesel shunting locomotives Маневровые тепловозы				
	TOTAL Всего	TEM2 ТЭМ2	TEM2A ТЭМ2А	TEM2U ТЭМ2У	TGK ТГК
KZYL-ORDA Кзыл-Орда	16	6	4	4	2
KAZALINSK Казалинск	15	1	1	13	
SAKSAULSKAYA Саксаульская	6	4	1	1	
CHIILI Чиили	6	5	1		
CHELKAR Челкар	6	5		1	
EMBA Эмба	5	3	1	1	
KANDAGACH Кандагач	21	17		4	
AKTYUBINSK Актюбинск	14	11		3	
SHUBAR-KUDUK Шубар-Кудук	5	5			
URALSK Уральск	16	14		2	
MAKAT Макат	14	10	1	3	
AKTAU Актау	9	9			
ATYRAU Атырау	16	11	4	1	
BEINEU Бейнеу	4	4			

Attachment of locomotives of the Tselinnaya railway as of 01.1.93

Приписной парк локомотивов Целинной железной дороги на 01.01.93 г.

Depot name Название депо	Electric line locomotives Магистральные электровозы			
	Total Всего	VL80 T ВЛ80 Т	VL80C ВЛ80С	VL60K ВЛ60К
NOVO-ISHIMSKAYA Н-Ишимкая				
BOROVOYE Боровое				
TSELINOGRAD (AKMOLA) Целиноград (Акмола)	164	80	19	65
KOKCHETAV Кокчетав				
ESIL Есиль				
TOBOL Тобол				
ATBASAR Атбасар	125	114	11	
KUSHMURUN Кушмурун				
KUSTANAI Кустанай				
ERMENTAU Ерментау				
PAVLODAR Павлодар				
EKIBASTUZ Экибастуз	70		70	
KARAGANDA Караганда	112		112	
ZHANA-ARKA Жана-Арка				
BALKHASH Балхаш				
AGADYR Агадырь	50		50	

Attachment of locomotives of the Tselinnaya railway as of 01.1.93

Приписной парк локомотивов Целинной железной дороги на 01.01.93 г.

Depot name Название депо	Diesel line locomotives Магистральные локомотивы						
	Total Всего	2TE10L 2Т310Л	2TE10V 2Т310В	TE3 Т33	2TE10M 2Т310М	3TE10M 3Т310М	2TE10UT 2Т310УТ
NOVO-ISHIMSKAYA Н-Ишимская	26	3		18	5		
BOROVOYE Боровое	70	3	63			3	1
TSELINOGRAD (AKMOLA) Целиноград (Акмола)	1			1			
KOKCHETAV Кокчетав							
ESIL Есиль	3	3					
TOBOL Тобол	18	13	4	1			
ATBASAR Атбасар							
KUSHMURUN Кушмурун	7			7			
KOSTANAI Кустанай	48	3	26.5	6.5	5	7	
ERMENTAU Ерментау	30.5	27.5	0.5	2.5			
PAVLODAR Павлодар	80	75		1			4
EKIBASTUZ Экибастуз							
KARAGANDA Караганда	29.5	20.5		4		5	
ZHANA-ARKA Жана-Арка	40	18	7		15		
BALKHASH Балхаш	26.5	1	4	10.5	11		
AGADYR Агадырь	3.5			3.5			

Attachment of locomotives of the Tselinnaya railway as of 01.1.93

Приписной парк локомотивов Целинной железной дороги на 01.01.93 г.

Depot name Название депо	Diesel shunting loccomotives Маневровые локомотивы					
	Total Всего	TEM1 ТЭМ1	TEM2 ТЭМ2	TEM2A ТЭМ2А	TEM2UM ТЭМ2УМ	CHME3 ЧМЭ3
NOVO-ISHIMSKAYA Н-Ишимская	12	3	6	2	1	
BOROVOYE Боровое	35	1	32	2		
TSELINOGRAD (AKMOLA) Целиноград (Акмола)	40	2	6	5	27	
KOKCHETAV Кокчетав						
ESIL Есиль	16		14	2		
TOBOL Тобол	16	2	14			
ATBASAR Атбасар	15	1	14			
KUSHMURUN Кушмурун	18	6	8			4
KOSTANAI Костанай	21	3	13	4	1	
ERMENTAU Ерментау	6		6			
PAVLODAR Павлодар	39		26	1		12
EKIBASTUZ Экибастуз	26		21	2	3	
KARAGANDA Караганда	41		22	2		17
ZHANA-ARKA Жана-Арка	10		10			
BALKHASH Балхаш	4		4			
AGADYR Агадырь	5		5			

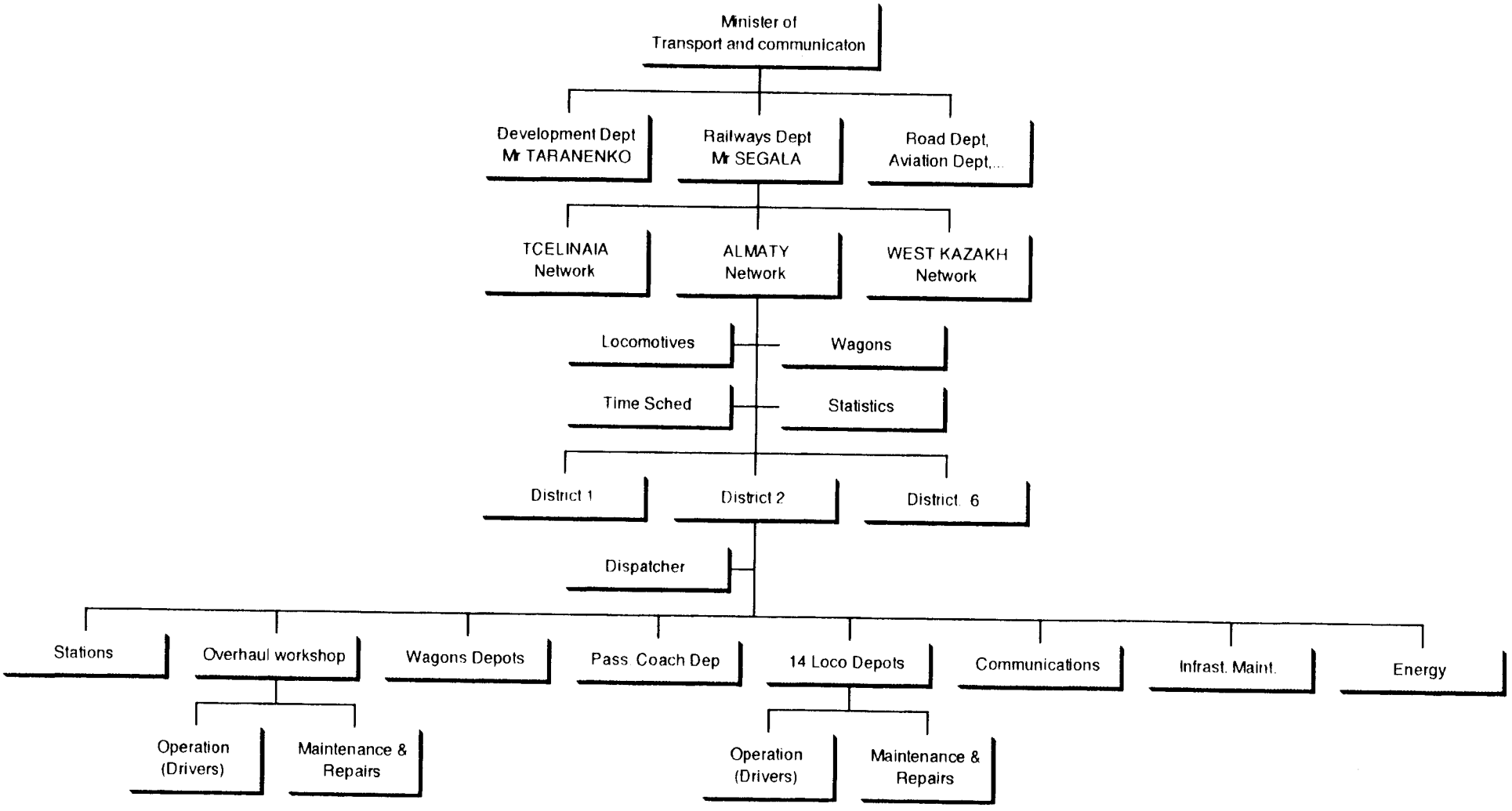
KAZAKSTAN Appendix 10

Volumes of freight traffic on railway sections

No	Section name	km	Direc-	Volumes of mln.t / year 89	92	93	1 sem 93	1 sem 94
1	Lokot - Aktogai	587	>	22.2	13.8	8.7	5.3	2.0
	Локот - Актогай		<	8.3	7.0	4.4	2.3	1.9
2	Aktogai - Matai	146	>	19.6	13.2	7.4	5.3	1.7
	Актогай - Матай		<	8.4	6.2	4.8	2.0	1.5
3	Matai - Almaty	411	>	18.1	11.8	7.3	4.5	1.5
	Матай - Алматы		<	8.8	6.7	4.0	2.1	1.5
4	Almaty - Shu	311	>	15.5	9.9	6.5	3.9	1.4
	Алматы - Шу		<	17.4	14.6	12.6	6.9	4.9
5	Shu - Lugovaya	115	>	43.8	21.7	13.1	7.8	4.4
	Шу - Луговая		<	17.8	12.2	8.1	4.1	3.4
6	Lugovaya - Zhambyl	118	>	41.9	20.2	12.3	7.5	3.8
	Луговая - Жамбыл		<	22.3	14.6	9.9	5.0	3.8
7	Zhambyl - Shimkent	254	>	46.9	23.3	14.4	8.7	4.3
	Жамбыл - Шимкент		<	21.4	14.3	9.4	4.5	3.9
8	Shimkent - Arys	79	>	52.3	28.1	16.2	7.8	3.7
	Шимкент - Арысь		<	19.1	11.7	7.1	3.5	3.2
9	Arys - Chengeldy	77	>	53.5	27.4	15.5	9.1	4.8
	Арысь - Ченгельды		<	19.4	10.4	6.0	3.1	2.4
10	Arys - Kzyl-Orda	393	>	20.9	12.2	7.3	4.2	2.5
	Арысь - Кзыл-Орда		<	23.4	14.4	9.8	5.1	4.0
11	Kzyl-Orda - Kandagach	939	>	18.1	10.9	5.5	2.8	2.2
	Кзыл-Орда - Кандагач		<	24.4	14.8	10.1	5.1	4.6
12	Kandagach - Iletsk	295	>	16.9	11.2	5.8	2.9	2.4
	Кандагач - Илецк		<	21.1	12.6	7.2	3.7	2.5
13	Iletsk - Ozinki	388	>	13.0	8.0	4.9	2.6	1.4
	Илецк - Озинки		<	10.9	6.6	4.2	2.3	1.0
14	Druzhba - Beskol	161	>	0.0	0.2	0.3	0.2	0.1
	Дружба - Бескол		<	0.0	0.8	0.7	0.4	0.2
15	Beskol - Aktogai	143	>	0.3	0.2	0.3	0.2	0.1
	Бескол - Актогай		<	0.5	1.2	1.1	0.5	0.2
16	Aktogai - Sayak	186	>	3.5	1.4	1.0	0.6	0.3
	Актогай - Сайяк		<	2.1	3.4	2.0	1.1	1.0
17	Sayak - Balkhash	206	>	6.7	3.8	3.6	1.8	1.5
	Сайяк - Балхаш		<	2.2	3.5	2.1	1.0	1.1
18	Balkhash - Mointy	132	>	3.7	1.4	0.9	0.5	0.3
	Балхаш - Моинты		<	4.5	5.3	3.9	1.8	1.9
19	Shu - Mointy	438	>	7.6	4.7	3.1	1.5	1.4
	Шу - Моинты		<	37.1	18.9	13.4	7.7	5.7
20	Mointy - Zharyk	215	>	7.6	5.2	3.8	1.8	1.5
	Моинты - Жарык		<	38.4	23.5	18.1	9.7	7.6
21	Zharyk - Karaganda (sorti	144	>	16.6	14.8	14.2	6.8	5.8
	Жарык - Караганда (сортирово		<	39.1	23.6	21.2	11.0	9.4
22	Karaganda(sorting) - Akm	218	>	34.9	27.1	19.0	9.4	8.3
	Караганда(сортиров) - Акмола		<	48.0	35.7	24.1	12.3	11.7
23	Akmola - Kokchetav	296	>	43.1	37.2	23.2	12.8	9.4
	Акмола - Кокчетав		<	10.8	8.0	5.8	3.4	1.9

24	Kokchetav - Petropavlovs	195	>	15.6	12.1	9.4	4.4	3.4
	Кокчетав - Петропавловск		<	7.4	4.6	3.3	1.6	0.8
25	Kulunda - Pavlodar	138	>	19.8	13.7	7.4	3.8	2.0
	Кулунда - Павлодар		<	21.6	20.0	17.9	8.9	7.1
26	Pavlodar - Ekibastuz	132	>	25.8	18.6	10.0	5.3	3.0
	Павлодар - Экибастуз		<	36.0	35.2	32.2	15.5	14.9
27	Ekibastuz - Akmola	306	>	72.8	60.1	49.3	24.8	20.7
	Экибастуз - Акмола		<	17.3	15.6	13.7	6.3	5.3
28	Akmola - Tobol	664	>	37.1	28.7	25.1	13.3	10.2
	Акмола - Тобол		<	27.4	21.7	15.0	7.5	5.7
29	Kzyl-Tu - Kokchetav	203	>	10.1	3.9	0.6	0.4	0.2
	Кзыл-Ту - Кокчетав		<	5.9	2.0	0.5	0.3	0.1
30	Kokchetav - Novo-Ishimsl	188	>	36.5	28.9	15.7	8.9	5.6
	Кокчетав - Ново-Ишимская		<	7.4	5.1	2.7	1.8	0.7
31	Novo-Ishimskaya - Kustai	223	>	7.3	7.3	1.9	1.0	0.5
	Ново-Ишимская - Кустанай		<	5.6	3.3	2.0	1.1	0.6
32	Kustanai - Zolotaya Sopk	166	>	6.4	7.3	8.0	4.0	2.3
	Кустанай - Золотая Сопка		<	1.9	1.8	0.6	0.3	0.1
33	Novo-Ishimskaya - Presn	148	>	29.1	21.5	12.3	7.3	4.9
	Ново-Ишимская - Пресногорков		<	2.7	2.9	0.8	0.7	0.1
34	Tobol - Zhelezorudnaya	50	>	8.5	5.9	8.8	4.9	3.4
	Тобол - Железорудная		<	17.6	12.5	9.1	5.5	2.7
35	Zhelezorudnaya - Kustan	46	>	7.6	5.5	9.6	5.0	3.1
	Железорудная - Кустанай		<	2.3	1.6	1.6	0.9	0.5
36	Nikel-Tai Kandagach	135	>	24.2	14.5	7.0	3.7	2.4
	Никель-Тай - Кандагач		<	11.4	6.4	3.7	1.9	1.1
37	Kandagach - Makat	392	>	20.1	12.2	5.1	2.7	1.3
	Кандагач - Макат		<	11.7	7.2	4.8	2.4	2.2
38	Makat - Akturau	125	>	17.6	13.0	7.6	3.9	2.7
	Макат - Актурау		<	17.0	13.4	9.5	5.0	3.2
39	Akturau - Aksaraiskaya	326	>	15.9	12.1	7.5	3.6	2.1
	Актурау - Аксарайская		<	13.0	9.6	6.0	3.7	2.2
40	Makat - Beineu	301	>	18.3	12.9	8.4	4.8	2.1
	Макат - Бейнеу		<	12.5	8.1	6.4	3.3	2.3
41	Beineu - Mangishlak	403	>	4.9	2.6	1.1	0.6	0.4
	Бейнеу - Мангишлак		<	4.7	2.8	1.1	0.6	0.3
42	Mangishlak - Uzel	179	>	0.8	0.5	0.3	0.2	0.1
	Мангишлак - Узел		<	0.5	0.4	0.3	0.1	0.1

KAZAKHSTAN Railways Organisation



Chapter 3 UZBEKISTAN Railways

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1. General data on network

1.1 Infrastructure

Length of the network is 3655.7 Km whereof 680.6 km are double track. There are 11 workshops for locomotive maintenance. The track gauge is 1520 mm and the average distance between two stations is 10-15 km. There was no information available concerning profile and tunnels (secret)

They have 480 km electrified double track (25 kV AC).

The lines have border as following
Chengeldi (excl) - Baineu (excl).....Kazakstan
Tahiatash (excl) - Cubadag (excl).....Turkmenistan
Cross-point 449 (excl) - Gazachak (excl).....Turkmenistan
Hodjadavlet (incl) - Talimardjan (excl).....Turkmenistan
Cross-point 161 .....Turkmenistan
Bekabad (incl) - Kanibadam (excl).....Tjadikistan
Sari-assia (incl) - Amuzang (excl).....Tjadikistan
Uch-Kurgan (incl) - Kara-su (excl).....Kirgistan
Hanabad (incl) - Kisil-kia 8excl).....Kirgistan

1.2 Management organisation

Uzbekistan railways is divided into five railway departments:

- 1 Tashkent (Tashkent)
- 2 Ferganar (Kokand)
- 3 Bukhara (Bukhara)
- 4 Aral area (Kungrad)
- 5 Karshi (Karshi)

Each of them are like a small indepentend railway organisation except on the economical/financial questions

1.3 Operation characteristics

Transport information

Freight loading/unloading is possible on 180 stations in Uzbekistan. Loading of tank wagons with oil and oil products for export is possible on the following stations: Karauid-Bazar, Sulphur factory, Shurtan, Akhunbabava, Altiarik and Pakhta. The capacity is 20 trains/day (66 wagons each).

Temporary storing of freight is not on the responsibility of the Uzbekistan Railways. Clients are responsible for the storing of freight

Loading of 20-feet containers is possible on 11 container terminals in Shumilava, Djizak, Karir, Margilan, Andijan, Raustan, Ulugbek, Tinchlik, Bukhara, Karshi, Urgench. Loading of 40-feet containers is only possible to do in Shumilava by a private company.

The volume of passenger and freight transport for 1989 to 1993 is shown below:

Year	mil passenger-km	mil ton-km
1989	5548	78716
1990	5450	76783
1991	5719	72404
1992	5653	50634
1993	5887	39254

No further information about 1994, 1995 and 1996 on this question.

Quantity of passengers transported in 1989 - 1995 (in thousand)

Type	1989	1993	1994	1995
International	3902	2088	2098	1390
Domestic	9069	6641	7602	2281
New local (metro)	19090	12727	13779	19771
Total	30549	21459	23479	14442

Quantity of freight transported in 1989 - 1995 (in thous. ton)

Type	1989	1993	1994	1995
Coal	8847.4	3491.3	2475.9	3614.0
Oil	16973.5	14150.7	11871.6	16155.9
Ore	1719.7	2511.0	1948.9	
Cotton	2541.0	1477.9	1307.6	1356.5
Total	123185.5	57232.0	40059.6	46209.7

Transportation of freight types in % of total (1995)

Type	100 %
Grain and bread products	3.6
Coal	8.8
Oil and oil products	11.8
Black metal	1.2
Wood	0.2
Chemicals	4.6
Construction materials	36.9
Cement	5.6
Cotton and other things	27.3

Delays and accidents from 1992 - 1995

Type	1992	1993	1994	1995
Serious accidents (deathly)	0	0	1	0
Materiel damage	1	1	0	1
Train crash	0	0	0	1
Derailments	7	0	21	21
Delays more than 1 hour	229	174	173	121
In general	654	597	413	252

1.4 Operation organisation

The superior management of train operation is made by the main operation centre in Tashkent, each geographical department has its own local train operation centre. Some lines are provided with auto-block signal systems and some stations are fully automatic.

Maximum train speed:
passenger..... 100 km/h, average 60 km/h
freight.....80 km/h, average 38 km/h

Average distance between two stations is 10-15 km and average running time for a train between two basic stations is 4-6 hours.

Daily average of passenger trains : 20
Daily average of freight trains : 130

Distances produced per day and per annum:

Type of rolling stock (Unit)	per day (km)	per annum (1000 km)
Locomotives	300 -350	109.5 - 127.75
Passenger wagons	700 - 800	255.5 - 292
Freight wagons	200 - 250	73 -91.25

Weight of an average freight train is 3500 - 5000 ton. The weight of an average freight wagon is about 22 ton and they can load 65 - 70 ton each. A normal freight train consist of about 55 - 60 wagons.

Railway education system:
- Tashkent Institute of Railway Engineers
- 3 Technical schools for railway technicians
- Medical technical school of the railway
- Road technical school

1.5 Economical results of operation

Economical information (planned and realised)

Costs (mil sum)

Purpose	1989	1991	1993	1994	1995	1996	1997	1998
Transport	0.7	1.7	142.0	1 105.8	9 611.6	11 885.0	14 262	15 300
Maintenan	0,1	0.2	16.2	170.4	1 091,5	1 518.0	1 973	2 170
Constructio	149.0	214.9	38.2	504.0	2 087.5	11 155,3	20 177	20 472
Total	149.9	216.8	196.4	1 780.2	12 790.6	24 558.3	36 412	37 942

Income (mil sum)

Type	1992	1993	1994	1995	1996	1997	1998
Freight	17.133	162.982	1974.616	8119.015	7228,204	8508,962	8778,477
Passenger	1.057	12.486	137.199	597,808	607,233	626,629	646,565
Total	18.190	175.468	2111.815	8716.823	7835.437	9135.591	9425.042

2. Rolling stock

2.1 Locomotives

All freight wagons are from Russia. except for the refrigerator wagons which are from Germany.
All locomotives are from Russia. except for shunting locomotives ChE3 which are from Czechoslovakia.

There are 11 workshops for locomotive maintenance . 3 workshops for passenger wagons maintenance and 8 workshops for freight wagons maintenance

Locomotives by December 1995

1 Line Diesel locomotives

Type of locomotive	Quantity of locomotives	Quantity of units
3TE10M	121	363
2TE10P	53.5	107
2TE10V	81	162
2TE10M	176.5	353
2TE116	48	96
2TE2	0.5	1
TOTAL	**480,5**	**1082**

2. Shunting locomotives

Type of locomotive	Quantity of locomotives	Quantity of units
TEM2	185	185
ChME3	128	128
	313	313
	793,5	**1395**

3. Electrical locomotives

Type of locomotives	Quantity of locomotives	Quantity of units
3VL80S	34	102
2VL60K	21	42
VL80S	1	1
VL60K	28	28
Total	**84**	**173**

4. Train sets

Type	Quantity of sets	Quantity of units
ER9E	33	66
ER2	12	24
Total	**45**	**90**

Train sets of type ER2 is using DC energy and that is why they do not use them anymore.

Age of the fleet

1. Diesel locomotive

Type	Quantity	Age (years)						
		30	**30-26**	**25-21**	**20-16**	**15-11**	**10-6**	**5-0**
3TE10M	121					99	22	
2TE10P	53.5			29	24.5			
2TE10V	81				77	4		
2TE10M	176.5					103.5	70	3
2TE116	48				31	17		
2TE2	0.5						0.5	
TEM2	185		17	66	58	38		6
ChME3	128					61	63	4
Total	**793,5**		**17**	**95**	**190,5**	**322,5**	**155,5**	**13**

2 Electrical locomotives

	Quantity	**Year of purchase**
3VL80S	34	1987 - 1991
2VL60K	21	1961 - 1967
VL80S	1	1984
VL60	28	1961 - 1967
Total	**84**	

About 58% is older than their normal using period.

3 Train sets

	Quantity	30	30-26	25-21	20-16	15-11	10-6	5-0
ER9E	33					12	21	
ER2	12			8		4		
Total	**45**			**8**		**16**	**21**	

2.2 Passenger coaches

There are about 200 coaches out of order due to the age (more than 28 years). The total amount of wagons is 1457 wagons.

Schema concerning the age of the passenger wagons fleet, planned years of operation is 28 years

Year	SV	TSMK	TSMO	MObl	P/V	VR	Other	Total	%
1950-59		1			15		7	23	1.6
1960-69		86	23	49	24	23	20	225	15.5
1970-79	16	133	365		20	8	6	548	37.7
1980-89	9	196	310			31	5	551	37.9
1990-95	2	60	40			4	1	107	7.7
Total	**27**	**476**	**738**	**49**	**59**	**66**	**39**	**1454**	

Condition of fleet
100 wagons are out of order due to the high age (more than 28 years)

2.3 Freight wagons

Amount of wagons and their age:

Type	19??-1969	1970-79	1980-89	1990-95	Total
KR closed	2169	3527	2856	418	8970
PL platform	1652	1412	1344	161	4569
PV open	693	2012	3679	641	7025
TsS tank	1531	1310	1362	281	4484
XX refrig	167	70	1564	104	1905
PR closed	1287	828	3012	449	5576
Total	7499	9159	13817	2054	32529

Included in the PR fleet they have 358 container wagons. 5724 wagons (+10%) are out of order as they do not need them at the moment with the present freight volume to transport on the railways.

They are not very sure on the correct number of wagons as they still have some wagons abroad since the independents. By the end of May they are going to count all wagons within Uzbekistan to make a status.

3. Maintenance

3.1 Locomotives

Maintenance work in the workshops

1. Electrical locomotives and train sets

Number of workshop	Name of workshop	Type of work (inspection)
Tch-12	Uzbekistan	TO-2; TO-3; TR-1; TR-2; TR-3

2. Diesel locomotives (mainline and shunting)

Tch-1	Tashkent	TO-2; TO-3; TR-1; TR-3
Tch-3	Kokand	TO-2; TO-3; TR-1; TR-3
Tch-4	Andijan	TO-2; TO-3; TR-1; TR-3
Tch-5	Samarkand	TO-2; TO-3; TR-1
Tch-6	Bukhara	TO-2; TO-3; TR-1
Tch-7	Tenchlik	TO-2; TO-3; TR-1
Tch-8	Karschi	TO-2; TO-3; TR-1
Tch-9	Termes	TO-2; TO-3; TR-1
Tch-10	Urgench	TO-2; TO-3; TR-1
Tch-11	Kungrad	TO-2; TO-3; TR-1
Main workshop	Tashkent	KR-1; KR-2

Data concerning rolling stock maintenance

1 Electrical locomotives

Main maintenance (KR-1) of electrical locomotives is made in foreign countries:

Year	1990	1991	1992	1993	1994	1995
Number of units	11	10	12	1	9	9

In 1994 they carried out TR-3 on 26 units, in 1995 they planned to carry out TR-3 on 45 units.

2. Diesel locomotives

Realised maintenance production within the last four years

Country/origin	1992 KR-1.2	1993 KR-1.2	1994 KR-1.2	1995 KR-1.2	1996 Kr-1.2
Uzbekistan	98	68	65	83	74
Industry	222	250	3	10	20
Tadjikistan			4	9	14
Kirgistan			5	3	13
Kaz Almaty			96	23	10
Kaz west			53	3	
Total	320	318	226	131	131

Data concerning planned and realised maintenance production

The plan of maintenance of locomotives was made in accordance to the data of the existing fleet and the guidelines given from maintenance manuals.

1. Electrical locomotives and train sets

The estimated numbers of KR-1 and KR-2 inspections are shown below:

Type of electrical locomotive	Kr-1 per unit	KR-2 per unit
3VL80S	8.5	8.5
2VL60K	3.5	3.5
VL80S	0.1	0.1
VL60K	2.3	2.3
Total	14.4	14.4

They planned to carry out 28.8 KR(1,2) inspections in 1995, but they only succeeded in carrying out 9.

3.2 Passenger wagons

Production

Type of inspection	**period**	**planned production 1996**	**estimated costs (sum)**
TO-1	before operation		
TO-2	6 months		
TO-3	12 months	1000	200.000.000,-
KR-1	5 years	350	192.500.000,-
KR-2	20 years	120	120.000.000,-

Workshops where to carry out the maintenance:

Tashkent main maintenance workshop	KR-1; KR-2
Tashkent. Vch D-2 workshop	KR-1; TO-1; TO-2; TO-3
Andijan. workshop	TO-1; TO-2; TO-3

Main suppliers are from Germany (Amendorff). delivery time about 12 months and Russia (Tver) delivery after payment

The amount of money to procure materials and spare parts to maintain the wagon fleet is approx. 6-7 mil usd per year They need to procure: wheels. couples. bogies, parts to the brake system. air-condition. electrical system (generators. relays etc.) and wood.

Due to lack of spare parts they can not full fill their planned maintenance program. They have to operate with wagons over-ran

3.3 Freight Wagons

The planned inspection system consist of

TO-1 and TO-2 inspection are carried out on all freight loading stations of which they have 180 in all Uzbekistan If damages appear which they can not repair locally. they have to send the wagon to one of the above mentioned workshops located on small stations within the respective department:

Department	Number of workshops	Comments
Tashkent	6	Small repair and TO-3
Ferganar	4	- - - -
Bukhara	5	- - - -
Aral area	4	- - - -
Karshi	3	- - - -
Total	22	

Maintenance at level TR-1. TR-2. KR-1 and KR-2 has to be carried out in the following workshops:

Department	**Location of workshops**	**Level of maintenance**	**Type of wagons connected to the workshop**
Tashkent	Tashkent	TR-1. TR-2. KR-1. KR-2	KR. PV
	Havast	TR-1. TR-2. KR-1. KR-2	PR
Ferganar	Kokand	TR-1. TR-2. KR-1. KR-2	TsS
Bukhara	Bukhara	TR-1. TR-2	PV. TsS
Aral area	Kungrad	TR-1. TR-2	KR. PL
Karshi	Karshi	TR-1. TR-2. KR-1. KR-2	KR. PL
	Termer	TR-1. TR-2	KR. PV

In Tashkent Department there is a workshop (Sirdarinski) for all maintenance of all refrigerator wagons in Uzbekistan.

To assist in carrying out TR-2, KR-1 and KR-2 they have a workshop in Pahtabad (Tashkent) for wagons of the type: PV and TsS, furthermore the workshop produce spare parts on request.

Furthermore they have two cleaning centres for all freight wagons, one is located in Ferganar and one in Bukhara.

Tank wagons are maintained in one workshop in Ferganar and one in Bukhara

They have no information about break-dawn frequency or amount of repair. They have just started a new system concerning centralised information collection to secure a central overview of the present condition of each wagon.

They could not give me any information concerning workshop capacity, planned 1996 and production realised up to date.

They can buy all spare parts in Russia (if they have money), 2-3% they can produce themselves in Uzbekistan. Their main problem is supply of bogies as they can not produce them themselves.

3.4 Surveys of new organisation

They do not have a Main Workshop for main overhaul of their electrical locomotives. This maintenance has to be carried out in Russia. They are negotiating with the Japanese Government Fund (OECF) concerning a "profitable" credit about 100 mil $ in order to built such a Workshop in the area of the Uzbekistan Workshop (Tch-12) in Tashkent.

They are also negotiating with the Japanese concerning construction of a new main workshop/plant for construction and maintenance of their passenger wagons. The new workshop is foreseen to be located in the area of a former building material plant near Tashkent. Technology and equipment will be purchased by the the Japanese.

There is a governmental project concerning electrification of 3000 km rail road with help (credit) from Germany.

They are carrying out reconstruction of the workshop for open/closed wagons and platforms in Pahtaabab.

Within the TRACECA projects they have asked for support (10 mil $) to computers, telecommication equipment, wheels etc.

They are ready to work with the Europien Bank of Reconstruction and development if they will give credit in an adequate way instead of negotiating with Germany and Japan

The Uzbekistan Railways has also asked for governmental support (credit of 200 mil $) to development of the Railways (electrification, new locomotives etc)

Furthermore they are ready to contribute 3000 freight wagons to a commen UIC-fleet to carry out international transport. The wagons need to be maintained and they need money for this purpose as mentioned in the preamble of this report.

4. Conclusions

Their workshops are functioning despite of old technology within some areas.

The logistical system could be better and they need to increase organisation and cleanlyness within certain workshops visited

Undoubtly they can execute all described maintenance tasks on all rolling stock, if they have access to spare parts and materials needed.

They have certain problems to assign qualified workers to key positions as many experts especially russians were transferred during the independence.

The effiency and productivity could be higher.

The main problem is that they do not have transportation enough to cover their need for procurement of needed spare parts and materials to the existing fleet of rolling stock.

Especially they need a workshop to carry out main maintenance of their electrical locomotives.

They need workshops (own or private) to produce/maintain different electrical/electronical equipment as generators relays etc

They could not documentate the amount of maintenance based upon realistic transport information.

They could not documentate break-dawns, running hours, km-production per unit.

In generally they got maintenance descriptions and quality targets concerning all type of rolling stock, but the maintenance descriptions could undoubtly be revised if the information concerning amount of repair/frequency was available in a proper way, this to increase effiency and productivity.

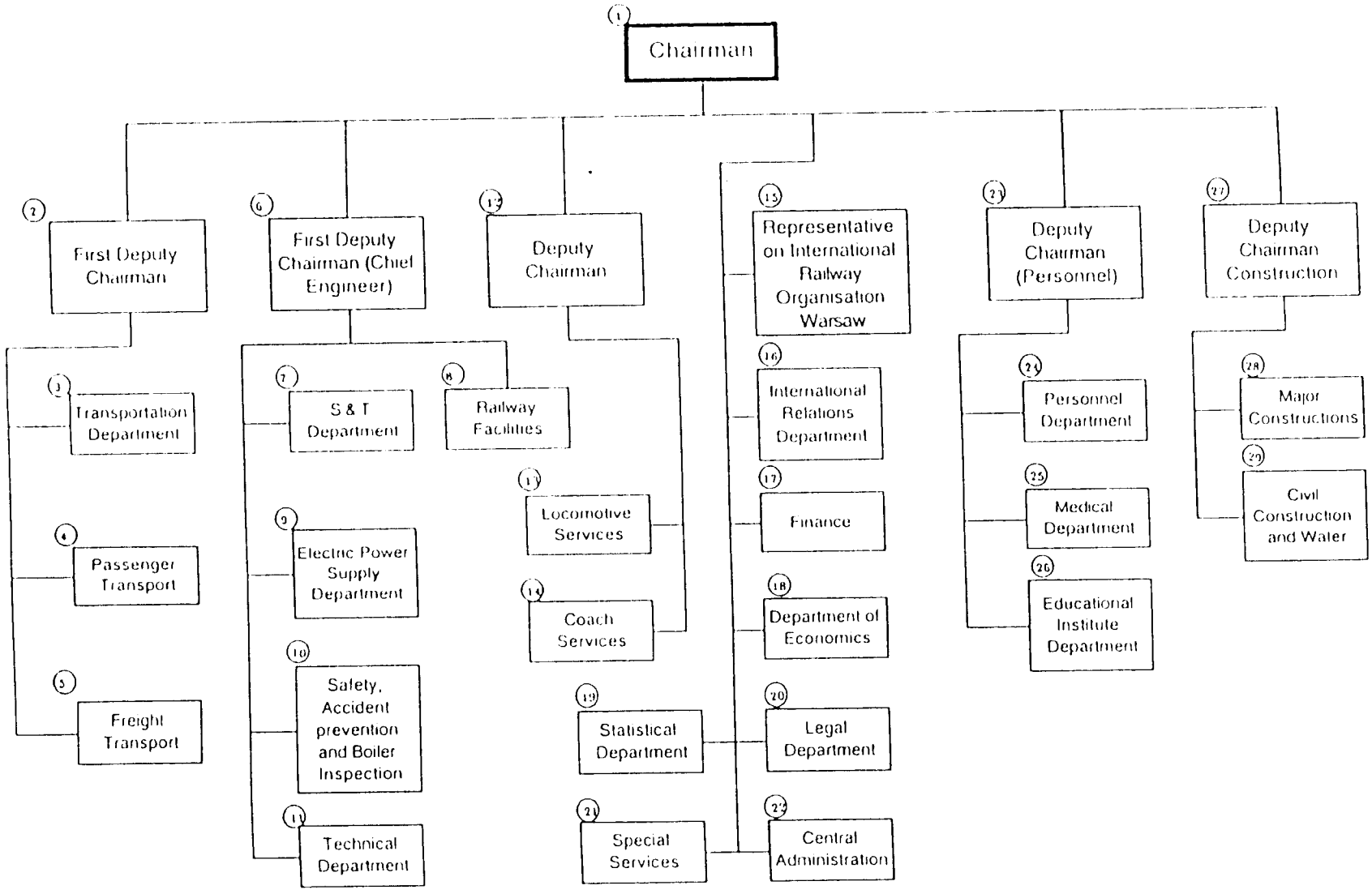

Figure 3-3-1: Uzbekistan Railway Organisation

Chapter 4 AZERBADJAN Railways

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1. Overall

1.1 Background

The Azerbaijan Railways (AZhD) were commenced in 1883, and in 1926 electrification of the first line was introduced.

Since the break-up of the former Soviet Union the Railways have suffered from a large drop in passenger and freight traffic, which has been further enhanced by the unrest in the Caucasian Region.

Apart from the line to Georgia all other lines to the neighbouring countries have been closed.

As a result there is now very little funds allocated for the maintenance of the rolling stock, and practically no foreign currency available for the purchase of spare parts and components abroad.

The AZhD fleet of vehicles is therefore in a very poor state and the entire operation is on the verge of being brought to a complete standstill.

At present more than 48.000 people are employed by the Railways, but the Consultant was told that in connection with a major re-organisation in August 1996 approximately 40% of the staff will be made redundant.

1.2 Railway network

The total length of the main track lines is 2.125 km of which 806 km are double track, and approximately 1.280 km or 60% of the line is electrified (3.3 kV DC).

1.126 km of the line have an auto-lock safety system, 450 km have a semi-auto-lock, and at the remaining length of the tracks the trains are under a central control.

The gauge of the track is the Russian standard gauge of 1.520 mm.

Total number of stations	:	177 including two marshalling stations
Average distance between stations	:	12 km
Max slope	:	25 o/oo length 13.9 km
Number of tunnels	:	15 (total length: 3.829 m)
Number of bridges	:	2.094
		35 bridges > 100 m long
		182 bridges 25 to 100 m long
		1677 bridges < 25 m long

On 400 km of the line, speed limits of 40, 25, and 15 km/h are now introduced because of the poor condition of the tracks.

A map of the network is enclosed as Annex 1.

1.3 Railway organisation

The present Railway Organisation consists of the following:

- 15 railway departments
- 6 loco depots
- 6 wagon depots

- 2 coach depots
- 9 signal divisions
- 6 power supply divisions
- 5 civil engineering divisions
- 3 loading/un-loading divisions
- 3 permanent way repair machine stations
- 1 protective affore station division
- 1 computer centre

and addition AZhD Railways is managing 7 industrial enterprises, trading centres, a railway college, a technical school, primary and secondary schools and kindergartens.

The industrial sites consists of the following:

- Facility for producing concrete slabs
- Cement brick factory
- Three quarries
- Track welding site
- Baku Tank Wagon Repair Plant

Since Independence some 150 Armenian and 200 Russian railway specialists have left AZhD.

As aforementioned the present number of employees totals more than 48.000 people, but a major re-organisation including a comprehensive forced redundancy programme is going to take place in the near future

The AZhD management was, therefore, very reluctant to show the present organisation sheet to the Consultant, but promised a new organigram would be available when the Consultant returns to Azerbaijan in September

1.4 Freight and passenger traffic

The break-up of the former Soviet Union and the following unrest in the entire Caucasian region have had a dramatically negative impact on the rail transportation of passengers and freight.

Whereas the passenger traffic is down 40°₀ in 1995 of what is was in 1989, the haulage of goods dropped to 5°₀ within the same period of time

The salient figures for the years 1989 to the first five months of 1996 are shown in the following table:

YEAR	PASS.KM	TON KM
1989	2.022.100	41.895.200
1990	1.827.200	37.076.000
199*	1.973.000	30.479.000
1992	1.625.800	13.782.000
1993	1.329.000	7.301.400
1994 *)	1.141.000	3.019.800
1995	791.400	2.245.900
1996 **)	216.200	1.058.200

*) 11 months

**) 5 months

2. Rolling stock

2.1 Electric Locomotives

AZhD has totally 152 electric mainline locomotives, powered by 3.000 V dc.

TYPE	kW	TOTAL NOS.	NOS. IN OPERATION	NOS. SICKLINE	NOS. OLDER THAN 30 YEARS
VL 8	4200	207	115	92	160
VL 11	5360	43	35	8	2
VL 22	2400	1	0	1	1
VL 23	2400/ 3150	2	2	0	2
TOTAL		**253**	**152**	**101**	**165**

The weight of the VL 8 and the VL 11 is 184 tons.

2.2 Diesel Locomotives

TYPE	HP (single unit)	TOTAL NOS.	NOS. IN OPERATION	NOS. SICKLINED	AGE (years)
TE 10	3.000	42	11	31	23 - 31
TE 3	2.000	22	12	10	7
M 62	2.000	24	7	17	7
TEM 2 *)	1.200	128	91	37	9 - 31
CHME 3 **)	993 kW	50	20	30	10- 15
TEM 1 *)	1.000	1	1	-	28
TOTAL		**279**	**147**	**132**	

*) Diesel shunters
**) Electric shunters
The weight of the diesel locomotives is around 125 tons per single unit

2.3 EMUs

TYPE	TOTAL NOS.	NOS. IN OPERATION	NOS. SICKLINED	AGE (years)
ER 2	74	44	30	11 - 26
CR 3	1	1	-	36
TOTAL	**75**	**45**	**30**	

2.4 Passenger coaches

Total nos of passengers coaches : approximately 700 (875)

Total nos of coaches in operation : approximately 300 (400)

The numbers in bracket are data from the Coach Depot

Average age is reported to be 10 to 15 years.

2.5 Goods wagons

Closed	6453
Platforms	4942
Semi-wagons	5860
Tank wagons	4948 *)
Reefers	2280
Misc.	5377
Other companies	1453
TOTAL	**31313**

Age distribution of wagons was not disclosed

*) 4-axle tankers 60 tons payload 8-axle tankers : 120 tons payload

As an illustration of the rapid deterioration of the wagon fleet more than 4000 wagons have been withdrawn from traffic during the last 18 months

December 1994 13.900 wagons out of service

July 1996 18.000 wagons out of service

3. Maintenance

3.1 Maintenance procedures

AZhD claims it still follows the rules and the regulations for the maintenance of the rolling stock as laid down in the former Soviet Union

The only exception is that AZhD has terminated the TR 3 for some of the locomotives due to lack of spare parts and the capital repair of the rolling stock (locomotives and passenger coaches) which was previously carried out abroad is no longer possible

As a result all locos and passenger coaches are long overdue capital repair, and the are only kept in traffic by repair or exchange of components taken from sick-lined vehicles.

3.2 Cost of maintenance

3.2.1 Locomotives and EMU

Due to lack of funds for spare parts regular TR 3 preventive maintenance has been terminated for some of the locomotives, and consequently no data is available concerning the inherent costs.

The costs of maintenance for 1995 are tabled here below.

Due to the high rate of inflation it is not meaningful to transform the costs in Manats to US Dollars, but the table clearly indicates that the relatively low costs spent on some of the locomotives creates a dangerous backlog of maintenance.

TYPE OF	VL 8	VL 11	CME 3	TEM 2	TE 3/TE 10	EMU	TOTAL
TO 3							
Labour	92,574	40,056	41,717	34,181	213,020	35,352	**456,900**
Materials	187,257	43,038	34,074	34,074	34,200	106,056	**438,699**
TOTAL	279,831	83,094	75,791	68,255	247,220	141,408	**895,599**
TR 1							
Labour	269,514	117,850	108,409	82,816	88,332	148,093	**815,014**
Materials	507,069	76,086	85,284	84,744	74,250	275,032	**1,102,465**
TOTAL	776,583	193,936	193,693	167,560	162,582	423,125	**1,917,479**
TR 2							
Labour	483,219	352,749	310,432	266,366	862,200	350,387	**2,625,353**
Materials	973,999	247,392	517,222	356,454	601,200	650,720	**3,346,987**
TOTAL	1,457,218	600,141	827,654	622,820	1,463,400	1,001,107	**5,972,340**
TR 3							
Labour	3,253,275					2,316,667	**5,569,942**
Materials	7,685,365					5,497,500	**13,182,865**
TOTAL	10,938,640					5,497,500	**16,436,140**
GRAND TOTAL	**13,452,272**	**877,171**	**1,097,138**	**858,635**	**1,873,202**	**7,063,140**	**25,221,558**

3.2.2 Passenger Coaches

Apart from the daily inspections and casual repairs the coaches are undergoing a preventive maintenance at depots once a year, and capital repairs are planned for every four years.

3.2.3 Freight Wagons

The wagons are maintained like the coaches except for the capital repairs, which take place every eight years.

3.3 Maintenance facilities

3.3.1 Locomotives

AZhD has six depots for locomotive maintenance:

- Baku
- Balajari (Baku suburb)
- Salyan
- Ganja
- Imishli
- Julfa

There are no facilities for capital repair of the locomotives.

Due to the blockade the Julfa depot has not been in operation during the last three years.

3.3.2 Freight Wagons

There are five depots for maintenance of freight wagons including the Capital Repair Plant.

The other four depots are located in:

- Balajari
- Kazi-Magomed
- Ganja
- Aliat

3.3.3 Passenger Coaches

AZhD has one depot in Baku for maintenance of passenger coaches.

3.4 Tank wagon capital repair plant

3.4.1 Background

The Tank Wagon Repair Plant was erected in 1893 at the time when the Azerbaijan Railways were built.

The total site is 300 ha.

The plant was originally built for the maintenance of steam locomotives, but was in 1920 converted to capital repair of tank wagons, which was to take place every eight years.

In general all the buildings need a thorough rehabilitation as proposed by the Consultant later in this report.

The staff was very proud of an international reward (Estrella de Diamante Internacional a la Calidad) for outstanding performance.

3.4.2 Capacity

At present approximately 250 are employed repairing around 120 wagons per month.

When spare parts were available in sufficient numbers the capacity of the plant was 230 tankers per month and 600 were employed.

3.5 Workshops

3.5.1 Machine Shop

In the machine shop ten lathes and other tool machines are installed. Average age of the machines is approximately 20 years.

Some of the machines are out of order mainly because of age and lack of spare parts.

3.5.2 Blacksmith

At the Blacksmith shop rivets and bolts are dropforged.

The presses seem to be in good working order.

3.5.3 Undercarriage Repair Shop

At the shop 15 tankers (4-axles) can be placed for undercarriage repair, and the bogies are reconditioned at two tracks.

A washing unit was seen in operation cleaning bogies and components.

All lifting gear has to be renewed, and the traverser, marshalling the tankers between the tracks is most probably beyond repair.

3.5.4 Tank Repair Shop

At the tank repair shop 9 wagons can be repaired on three tracks.

3.5.5 Wheel Shop

Dismantling of bearings is done in a very dirty environment and the procedures should be changed to ensure the bearings are not harmed at the process.

Two wheel lathes are installed - a very old Polish one and a Russian wheel lathe from 1980.

The crack detection of bearings is excellent and the entire bearing repair shop is very clean and tidy.

3.5.6 BALAJARI Washing Station

A washing station for cleaning the tank wagons was put into operation in 1938.

The Consultant did not visit the plant, but will do so at his return in September.

It is claimed the washing station is still in operation, but none of the tank wagons inspected by the Consultant were clean at the outside.

3.6 Passenger coach depot

3.6.1 Background

The coach depot was built in 1930.

At present 390 employees were claimed to be occupied by preventive maintenance, but only a fraction of this number could be seen in the shops.

3.6.2 Capacity

Yearly overhaul of coaches

The present capacity is 30 coaches per month provided spare parts are available. Out of 875 coaches only 400 are fit for traffic.

200 coaches are beyond repair

Average age 15 years.

Vandalism is of greater and greater concern and broken or missing windows were evident at practically all of the coaches

Main problems

electrical systems

brake system

Practically all spares from sick-lined coaches are now used up.

3.7 Workshops

3.7.1 Brake Shop

The brake shop is capable of repair and adjusting all brake valves. The equipment seems to be in good working order

3.7.2 Wheel Shop

The lay-out of the wheel shop is fine

Two polish wheel lathes are installed the youngest from 1987.

(All wheel lathes in the depots and plants should have a major overall to extend the lifetime).

3.8 Coach maintenance shop

3.8.1 Coach Shop

The main coach shop has space for 4 coaches to be lifted.

The lifting gear is very old and did not look very safe

The welding gear is from the 1960-is. and welding cables were at several points without any isolation.

3.8.2 Electrical Shop

In the electrical shop minor repairs including turning of commentators and cutting of mica can be carried out, but there are no facilities for winding of motors or test stands for testing of the motors/generators.

It was claimed that the generators could be repaired at an external plant in Baku but time was too limited for the Consultant to visit the plant

3.8.3 Shock Absorber Shop

At the shop the shock absorbers are tested by a good working equipment.

It is possible to print out diagrams during the test to judge whether the shock absorber is within the specified parameters

3.8.4 Carpentry Shop

A reasonable well equipped carpentry shop i standing idle due to lack of timber.

3.8.5 Light Repair

Running maintenance of the coaches is carried out at an open-air track with pits.

3.9 Loco depot

3.9.1 Background

The depot, positioned 20 km outside Baku, was erected in 1989.

Only TR2 preventive maintenance is carried out at present due to lack of spare parts.

Maintenance of diesel locomotives have been terminated due to lack of spare parts.

An agreement have been made with a Russian plant to do the capital repairs, but lack of funds has prevented the C/R to materialise

3.9.2 Staffing

The following number and category of staff is presently employed at the locomotive depot:

PROFESSION	PLANNED	ACTUAL
Engineers and Technicians	326	319
Loco Drivers	1280	1580
Assistant Loco Drivers	1034	1038
Fitters	744	586
Semi- and unskilled Workers	654	605
TOTAL	**4038**	**4113**

In addition to the depot in Baku there are two loco depots in Divichi and Shirven.

3.10 Workshops

3.10.1 Diesel Loco Shops

Three tracks where two were occupied by diesel locos presumably beyond repair, and nothing was going on in the shop.

3.10.2 Machine Shop

Most of the lathes and other tool machines are from app. 1960 and only few of them are in working condition.

3.10.3 Electrical Loco Shop

In the shop for electrical locomotives there are three tracks with lifting gear.

An old under floor wheel lathe (UF) is installed, but is to be replaced with a new Polish U/F wheel lathe from 1989 which is still in its original shipping box.

It was not disclosed why the Polish machine has not been installed, but the reason is most likely lack of forex for assistance for the installation.

When the new machine is installed it is planned that the old U/F should be used for capital repair.

The load bank (Rheostat) for testing of locos is out of order.

3.11 EMU depot

3.11.1 Background

Two trainsets, each consisting of six units, had just arrived from Ukraine where they had undergone a capital repair

The costs of the repair was claimed to be USD 400.000 for both sets.

Present price for new six-unit EMU is USD 3 mill.

Sungait Metallurgy Plant and Baku Machinery Plant (Sattarkan) can produce brake blocks.

Test of Sungait B/B has been carried out with a positive result.

3.11.2 Maintenance Procedures

TO 3	every five days inspection
TR 1	50 days interval
TR 2	as TR 1 plus inspection
TR 3	165.000 km include lifting

3.12 Workshops

3.12.1 Pantograph Shop

In order to prolong the lifetime of the pantographs short pieces of carbon were mounted enabling replacement of worn out pieces.

It is evident that the tracks and probably also the powerline are misaligned as it is clearly seen that the power line makes contact with the pantograph outside the carbon area.

3.12.2 Machine Shop

A number of lathes and other equipment from the 1950-ies, and only a couple of the machines were in working condition

3.12.3 Wheel Shop

A new Polish wheel lathe (Rafamet) was installed in 1990, but has been out of order for some time.

The machine is more sophisticated than the older ones and will most probably need a specialist from the manufacturer to do the repair

3.12.4 Electrical Motor Shop

The shop is only capable of doing maintenance at the outside of the motors i.e. commutators.

3.12.5 Varnish Shop

The shop is insulating the motors in working condition but no varnish available.

3.12.6 Maintenance Shop

A 10 years old U/F wheel lathe is installed and in working condition.

4. Consultant's proposal

Most of the proposals, suggested for the Armenian Railways, do also apply for the Azerbaijan Railways, except for the proposed funding of the completion of the Sleeper Plant in Armenia.

In addition it is proposed to improve the facilities in Baku for the capital repair of Tank Wagons, as oil is the most important export product for Azerbaijan

ANNEX 2.1

Required Spare Parts for Diesel Locomotives

Type	Amount	Price per Unit in USD	Total Cost in USD
Battery	100 sets	2.549.00	254.900
Battery	100	2.549.00	254.900
Main Inserts D 100	200 pieces	89.23	17.846
Inserts connecting rods	210 pieces	88.23	18.5280
Inserts connecting rods	250 pieces	88.23	22.058
Main inserts	250 pieces	88.23	22.058
Motoraxle bearings	30 pairs	269.00	8.070
Sprayers	100 pieces	49.01	4.901
Nozzles	100 pieces	88.23	8.823
Plunger s pair	100 pieces	39.20	3.920
Fuel pump	50 pieces	49.01	2.451
Nozzle	40 pieces	88.23	3.529
Sprayers	200 pieces	49.01	9.802
Loco Break blocks	10000 pieces	9.80	98.000
Electrobrushes	20000 pieces	3.60	72.000
Electrobrushes	11000 pieces	2 13	23.430
Total			**USD 825,216**

ANNEX 2.2

Required Spare Parts for Electrical Locomotives

Type	Amount	Price per Unit in USD	Total Cost in USD
Electrobrushes	2500 pieces	1.90	4.750
Electrobrushes	1000 pieces	4.76	4.760
Electrobrushes	1000 pieces	0.95	950
Electrobrushes	1000 pieces	0.85	850
Electrobrushes	2400 pieces	2.75	6.600
Angle insert	1600 kg	3.43	5.488
Cone pipes	1500 pieces	10.39	15.585
Exhaust chamber	200 pieces	82.35	16.470
Carriage Pantograph	60 pieces	32.94	1.976
Carriage Base Pantograph	20 pieces	4.90	98
Contactor	15 pieces	258.80	3.882
Contactor	15 pieces	258.80	3.882
Contactor	18 pieces	258.80	4.658
Contactor	18 pieces	258.80	4.658
Exhaust	25 pieces	82.35	2.060
Insert motoraxle hearing	20 sets	298.03	5.961
Total			**USD 82,628**

In all: USD 907,636

ANNEX 2.3

Required Spare Parts for Tank Wagons

Spare Parts	
Friction instrument	150 pieces
Feed-shaft of the fraction yoke	100 pieces
Spare reservoirs	100 pieces
Breathing valve	200 pieces
Bolts in assembling	100 pieces
Bolts (different dimensions)	500 pieces
Plugs for lower damping device	3000 sets
Rollers for the cramp of the lower damping device	500 kg
Screws of the damping device	2000 pieces
Split (different dimensions)	1000 pieces
Washers for the plugs of the damping device	1500 pieces
End-line - cockvalve	1000 kg
Inspection covers for axle-box	1000 pieces
Traction yoke	500 pieces
Turner	1000 pieces
Upperspring beam	100 pieces

ANNEX 2.4

Required Spare Parts for Capital Repair of Tank Wagons

Spare Parts	
Low grade steel	30 tons
Medium grade steel	40 tons
High grade steel	50 tons
Iron bars	15 tons
Cron roller	1.0 tons
Paint. Black. white. blue. red	5.0 tons
Electrodes for hot-welding	5600 tons
Grease for roller bearings	10 tons
Pipes. others	3.0 tons
Timber for wagon building	10.000 cub meters
Cutting tools for wheels	2000 pieces

Chapter 5 GEORGIAN Railways

Table of contents

1. Overall

1.1 General description of the network

The railways in Georgia are laid to the standard Russian gauge of 1520 mm and rails are set at 1 in 20 inclination. A mixture of concrete and timber sleepers are used with heavy section flat bottom rail. On the main line 25 tonne axle loads are accepted but on other lines the limit is 23 tonne.

Total route length is 1600 km and this includes approximately 255 km in the Abkhazetia region. From the border with this region to the main line at Senaki is about 39 km.

The Main Line is considered to extend from Senaki (2232 km from Moscow) to the Azerbaijan border: 278 km to Tbilisi Junction plus a further 42 km from the junction to Gardabani and the border. A total of 268 km of this is double track but there are presently some 40+ km in the Zestafoni to Khashuri section which are worked as single track due to river erosion of the track embankments. Work is in progress to restore this section to double track throughout.

There are two important lines connecting Black Sea ports to the main line. From Poti to Senaki is a distance of 41 km. and from Batumi to Samtredia is 106 km. The only other line of importance is from Tbilisi Junction (2510 km from Moscow) to the border with Armenia of 69 km. The three lines described herein are single throughout.

Some fourteen other country branch lines contribute approximately 775 km and the balance of distance is made up of triangulation of the junctions at Tbilisi, Khashuri and Samtredia.

On the whole network there are some 158 stations giving an average distance of just over 10 km between each. There are 34 stations on the main line, 3 on the Poti line, 10 on the Batumi line and 4 on the line to Armenia.

Maximum speeds, which used to be 100 km/hr for passenger and 80 km/hr for freight, are now limited to 60 km/hr and 40 km/hr respectively.

The section from Zestafoni to Khashuri is the most arduous on the network the line rising nearly 2000 m in just over 60 km. Ruling grades are as steep as 1 in 36 (2.8%) and, whereas trains of 3,500 tonne can be operated from Batumi and Poti to Zestafoni by a single locomotive, they are limited to 2,500 tonne on the Zestafoni to Khashuri section with three locomotives. In addition to the grades there are torturous curves with many radii as tight as 150 m.

There are seven tunnels on the main line, the three longest being 740 m between Dzirula and Kharagauli and 3998 m between Tsipa and Likhi (both in the Zestafoni to Khashuri section) and one of 1026 m near Mtskheta, some 20 km west of Tbilisi. The other four average 140m in length. There are also two tunnels on the Batumi line, the longest being 272 m and the other 102 m.

On the main line and the three other principal lines there are 472 bridges and 2 viaducts, twenty seven of the bridges being of steel construction. All other bridges are of stone or concrete construction. Considering bridges of over 75 m in length, there are 30 on the main line (including the two viaducts) of which 8 are of steel, 2 on the Poti line both of which are steel, 6 on the Batumi line including three of steel and 2 on the line to Armenia of which one is of steel construction.

The longest bridge is No. 1 on the Poti branch which is a steel bridge of 473 m. Other long bridges are No 151 on the Batumi line, 268 m (steel) and Nos. 33, 142 and 173 on the main line (208 m, 219 m and 208 m respectively).

1.2 Condition of the infrastructures

The trackwork is in poor condition due to a huge backlog of sleepers. There is currently an urgent requirement for over 50,000 sleepers. To do everything rightly 200,000 sleepers are needed of which 80,000 should be concrete. Concrete sleepers are used in the flatter areas, but in the mountainous region wooden sleepers are used because the current concrete sleepers do not permit sufficient gauge widening on the tight curves. In the last four years only 2,000 sleepers have been renewed. This situation also probably indicates that much of the ballast has not been attended to over the same period.

Locomotive sanding is used for assistance with adhesion and this is required when starting eastbound trains in the heavily graded section. Quartz sand is quarried from the mountains, washed graded and dried for use in the locomotives. In view of its use in the Zestafoni to Khashuri section it may be worth examining the trackbed conditions in this area as continued use of sand may have caused sufficient contamination of the ballast to prevent adequate drainage which in turn could lead to misalignments.

The railway has its own ballast plant for crushing and screening mountain rock but, although the capacity of the plant is sufficient to meet all the needs there is insufficient revenue available to meet its running costs.

There is track machinery in working order capable of meeting relaying of 80 km per year if sufficient materials were available. However, the current programme is for only 20 km per year. There is currently 250 km in need of renewal. A simultaneous track maintenance programme is in line with the current requirement for 100 km in this year and the capability exists to step this up to 200 km per year if materials are available

Although tests have been carried out with five locomotives coupled in multiple, normal working is limited to three units for bridge durability. Twenty seven bridges are damaged and currently have severe speed restrictions imposed.

1.3 Train operation

The communication system on the railway is currently not working, and therefore it is not possible to control train movements other than by letter!! There appears to be no centralised signalling, everything being done at local control posts

The semi-automatic block signalling is also defunct except for 60 km of track to the east of Tbilisi toward the Azerbaijan border. The railway is endeavouring to rebuild this semi-automatic block signalling.

In any case the track condition, inoperative signalling and lack of communications currently limits average train speed to as low as 5 to 10 kph.

90°o of the traffic on the main line is transit freight to and from the two Black Sea ports of Batumi and Poti through to Azerbaijan and Armenia.

The mountainous territory limits the trailing weight of the trains. In this area it requires three locomotives (two on the head and one pushing) to operate the trains which are limited to 2,500 to 3,000 tonne on this part of the route. The use of a pusher also helps to reduce the coupler stresses in the leading wagons of the train formation. A single locomotive can handle trains of 5,000 tonne to 7,000 tonne on other stretches of the line

Trains of over 3,100 tonne require special notice to run from Zestafoni to Khashuri as they are restricted in the number of places they can stop due to inability to start such heavy trains on the grades.

It is worth noting that train operations in the westbound direction are not so severe, as the grades to the summit at Khashuri more gradual, and it is possible for a single locomotive to haul the trains. However, for descent from Khashuri to Zestafoni two locomotives are put on the head of the train for brake power, particularly holding brake effect should the train be brought to a stop on the steeply graded sections.

There are several locomotive depots on the network. The depot at the port city of Batumi provides the power for trains from there and Poti to Samtredia. The section to Zestafoni is worked by locomotives from Samtredia. At Zestafoni the Samtredia locomotives are detached to work back and locomotives based at Zestafoni take over for movement on the heavily graded section to Khashuri.

There is another locomotive depot at Khashuri from which locomotives operate to Tbilisi. The depot at Tbilisi provides the locomotives for operations to Azerbaijan and Armenia.

The maximum number of locomotives used on the head of the train is two B-B twin units. This may also be indicative of concern in regard to concentration of locomotive weight on bridge structures and track formation in general.

2. Rolling stock

2.1 Locomotive fleet

The original fleet consisted of 300 electric locomotives but there are currently only 59 units operational. The current requirement for train operations is for 25 working electric locomotives, and it is anticipated that the maximum fleet requirement with the traffic flows that are expected will be no more than 90.

Electric Locomotives:				**Diesel Locomotives**				
Model	Working	Stored / Defunct	Total	**Model**	Working	Stored	Defunct	Total
ChME3	41	113	154	**VL22**	6	0	10	16
TEM2	11	14	25	**VL8**	27	8	52	87
TE3	1	6	7	**VL10**	16	7	63	86
2TE10u	2	1	3	**VL10u**	1	1	16	18
2TE10m	2	4	6	**VL11**	9	6	26	41
TOTALS	**57**	**138**	**195**	**TOTALS**	**59**	**22**	**167**	**248**

Each of the 3,300 VDC electric locomotive types consists of twin B-B units. The oldest electric locomotives, Class VL8, date from 1954 and are now beyond their economic working life with only a few remaining in service. Georgian State Railways consider the useful life of a locomotive to be 27 years.

The VL10 and VL11 models are 5,400 kW units of twin B-B configuration with cabs at the outer ends only (US "A" unit configuration). Each twin unit has all eight axles motored by axle hung DC traction motors

geared at both ends of the motor. Helical reduction gears are used to transmit power to the wheels and give a top speed of 100 km/hr. A higher geared version, model E13, for use in passenger traffic, has a top speed of 120 km/hr. each twin unit weighs 186 tonne (23.25 tonne axle load). The VL10u model is an upgraded version with many components similar to the VL11, and indeed there is a commonality of spare parts across the three types of electric locomotive.

Locomotives have been "robbed" of parts to keep others in traffic. Often three locomotives are used to obtain sufficient parts to make one operational, and it sometimes even takes four locomotives to achieve this. Ten of the "robbed" locomotives are currently in the Locomotive Building Factory for re-habilitation, and there are ten other locomotives which have been wrecked in collisions and derailments.

2.2 Passenger and freight wagons

The passenger car fleet consists of 1176 vehicles of which 534 are currently operational. There are nearly 20.000 freight cars in the fleet, of which only about 5,000 are currently operational.

Passenger Car Fleet	
Compartment Cars (2 berth)	69
Compartment Cars (4 berth)	436
Open Saloon Cars	516
Restaurant / Kitchen Cars	41
Buffet Cars	3
Luggage Vans	28
Postal Vans	3
Parcel Vans	38
Country Trains	25
Railway Officers Saloons	5
Engineering Inspection Saloons	6
Video Cars	2
Prison Vans	4
TOTAL	**1176**
Cannibalised for Spares	187
Out of Service (over age)	18
Left in Abkhazetia region	405
OPERATIONAL (as at 18/09/95)	**566**
(as at 24/05/96)	**534**

Recently a fleet of 780 Refrigerator Wagons was scheduled to be supplied as part of the World Food Programme. However, not all were delivered and a great many of them are now out of action as they "robbed" of parts to keep others in service.

The mountain territory contributes considerably to wagon wear and tear. The sharp curves cause considerable wheel wear which results in a short life of one year for the wheels compared to three years for vehicles not working in this region.

Freight Car Fleet	
Closed Wagons (Box Cars)	3901
Flat Wagons (Platforms)	2224
Open Wagons (Gondolas)	5874
Tank Wagons	2284
Grain Hoppers	1910
Refrigerator Wagons	752
Various (including service vehicles)	2017
Private Owner Wagons	869
TOTAL (All Types)	**19831**

In terms of financing US $1 million has been provided through the UNDP and a US $3.5 million loan has been raised with the World Bank. However, it is projected that a total of US $160 million is required. In 1995 a total of US $16 million was spent on repairing locomotives and rolling stock and the forecast for 1996 is US $25 million. The most urgent need for capital expenditure is seen to be a requirement for new Locomotives and Tank Wagons.

3. Maintenance facilities

Running maintenance is carried out on the locomotives in their respective depots at Batumi, Samtredia, Zestafoni, Khashuri and Tbilisi.

Heavy maintenance and repair of locomotives passenger cars and freight wagons is carried out at two plants in Tbilisi. There is one repair shop for locomotives, carriages and wagons, and a locomotive building facility. The former now only handles passenger and freight cars whilst the latter now undertakes locomotive overhaul and repair as it is under utilised since the cessation of substantive locomotive construction.

Spare parts are hard to come by as the traditional source for everything was Russia or the Ukraine. Many items are of bespoke Soviet design and as such are not readily interchangeable with European or American equipment without the replacement of complete systems e.g. brake equipment. Spare parts have not been traditionally manufactured in Georgia, but the current pressing situation is driving the railway to adopt some degree of self sufficiency. However, the current source for the majority of parts required is from stopped vehicles which are "robbed" to keep others in traffic.

3.1 The "Lenin" Locomotive Construction Plant

This facility, located in Tbilisi, occupies a site of 47 hectares. In the days of the Soviet Union it was capable of building 150 electric locomotives per year. The facilities were built in the late 1950s early 1960s and the buildings are spacious.

Construction of VL10 type locomotives commenced at the plant in 1961 and the VL11 model followed from 1975. The higher speed version, type E13, was built from 1985 on. In total the plant has built some 3,500 locomotives and supplied 30% of the locomotives for the former Soviet Union.

Currently they are not building main line electric locomotives although they have the capability to construct three design: VL10, VL11 and E13. The last two VL11 locomotives constructed are still on hands as the Transport Co-Ordinating unit has no funds to purchase them. However, an order for two industrial shunting locomotives is currently being filled for China: one being complete and awaiting inspection and the other well advanced. further orders for this type of locomotive are being pursued with the Russian Federation and Pakistan.

There are currently 6 of the VL11 type of locomotive undergoing repairs in the shop and a further 4 are awaiting attention. These units have been "robbed" of parts by the railway to keep other units in service. In addition a solitary VL15 unit, which has proved unsuitable for operation in Georgia is being dismantled for reclamation of components and sale of those items which it is not possible to use on standard models.

The plant was designed to be totally self sufficient and had its own machining and forging capability. All mechanical parts except wheels were manufactured in the plant, the latter being sourced from Russia. The facility had the capability to produce 90% of the brake equipment required for locomotives, the other 10% coming from Russia.

All electrical machines such as traction motors and compressor motors were manufactured in house as well as electrical switch gear and wiring harnesses.

The staff has been reduced from 5,000+ to around 2,500 in total, of which 10% are technical and administrative personnel. In addition to the General Manager, the "Top Team" consists of a Chief Engineer, Deputy GM (Production Engineering) and Deputy GM (Commercial & Supply). There are Department Heads for each of the main areas of Technical, Industrial and Construction, and each shop area has a Superintendent. The cash flow situation is currently so bad that the staff have not been paid for five months.

Due to financial and supply problems there are raw material and spare parts shortages in all areas. There is a critical shortage of wheels, bearing and batteries. However this plant has some tape controlled lathes which are used for batch production of turned items, but output is limited by availability of raw material. In general the machinery in the plant was more modern than that observed in the "Stalin" Rolling Stock Repair Plant.

3.2 The "Stalin" Rolling Stock Repair Plant

Like the "Lenin" locomotive construction plant there was little evidence of activity in the "Stalin" rolling stock repair plant even though there were at least twenty passenger carriages in for repair. Once again, lack of finance to buy materials and parts and to pay for the running costs of the plant were cited as reasons for the low output. It was also claimed that there was a lack of work due to shortage of electricity, but it was not determined if this was a real shortage or due to inability to meet payments for electricity.

There is currently a deficit of Lari 700,000 (US $560,000) in payments due from their sole client (Georgian Railways). This cash flow problem inhibits purchase of raw materials and spare parts, for example a stock of 15,000 m^3 of timber for wagon repair has now been completely depleted. The other most urgent problem is a lack of wheels.

Although locomotive overhaul and maintenance used to be carried out in this facility it has since been transferred to the Locomotive Construction Plant. This facility is now concentrating on passenger and freight car repair and maintenance. Additional freight car maintenance has been taken on since the beginning of the year in the locomotive maintenance bays. If there is no problem with material supply it is estimated by plant management that an output of 60 vehicles per month can be achieved.

However, the plant and machinery in the workshops is old fashioned, labour intensive, and depends on individual skills to maintain tolerances. There are no auto lathes or numerically controlled machines. This is not satisfactory if reliability of equipment is to be achieved.

There are ten lines in the plant connected by a traverser. Of these lines 1 & 2 are used for underframe repairs, 3 & 4 for "off the vehicle" activities and 5 & 6 are used for passenger carriage body finishing. Lines 7 & 8, formerly used for locomotive repair, are now used for freight wagon repair. Bogie overhaul is undertaken on lines 9 & 10 adjacent to which is the wheel and axle repair shop. In the latter new axles are even turned up on the lathes, but there is a lack of suitable steel, which is normally obtained from Russia. Wheels and journal bearings also currently come from Russia.

The plant has a staff total of 2,000 of which 150 are administrative or supervisory posts. Management is still very much on the "command & control" principle with very little enpowerment to shop floor workers in regard to task objectives. Although the workers have been trained well as artisans they depend heavily on instructions for each task. Supervision appears to concentrate on getting the task in hand complete, dealing with material shortages and necessary rework of items which should be scrapped. As a result it appears that forward planning is not a priority and that the urgency is directed to completing the task in hand. Performance is measured on the antiquated basis of "fulfilment of directions"

4. Recommendations

It is important that the exact amount of locomotives, passenger carriages and freight wagons required to operate services be determined and those vehicles suitable to be maintained for such traffic be identified. The current situation with regard to using parts from within a large fleet to keep a small number in action is time consuming and lacks control in regard to the standard of components being fitted to running vehicles

The Rolling Stock Repair Plant in Tbilisi can handle all the necessary passenger and freight car overhauls, but it is in need of a major tidy-up and some modern machinery for the production of common components.

The Locomotive Building Plant is a relatively modern facility and is spacious. It has great potential to be developed into a major locomotive overhaul and repair centre. However, in both shops there will be a need for supporting materials management to back up production activities.

The dependence on the Russian Federation for almost all material and spare parts supply is affecting availability of materials, and the bespoke design of some components makes interchangability with European or North American manufactured parts difficult. It is recommended that a detailed study at component level be carried out to ascertain the areas and components where a broader based interchangability could be achieved.

One safety critical area, in which there is also a great spare parts shortage, is that of axle journal bearings. A study of this area alone to determine if SKF/Timken/FAG bearings could be applied by modification of axle box housings would be worthwhile.

Whereas at first inspection there appears to be a problem only in the spare parts supply study has revealed that in many cases components could be manufactured if access to raw material was possible. For instance the ability of the Locomotive Construction Plant to manufacture brake components should be revitalised.

The railway in Georgia is dependant on transit traffic and this is only a small percentage of the volume in former days However, the fixed costs of the operation have not declined in line with revenue reductions and the result has been that in the absence of suitable cash flow levels maintenance expenditure has been cut back This has affected all areas of the railway from track and bridges to locomotives and rolling stock

In fact there is a summation effect in that the current track conditions contribute in turn to higher maintenance requirements.

Effective use of any capital investment must be assured, and it is imperative that any such projects be evaluated properly and that sufficient transfer of know how is given to back up the introduction of new plant methods and techniques.

Chapter 6 ARMENIAN Railways

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1. Overall

1.1 Background

Armenia is probably one of the most developed countries of all the TRACECA states in terms of industrialization

Arms industry and other factories are producing a wide variety of goods from semi-conductors to heavy machinery and for example are diodes for communications and signalling exported to Iran at a price which is only 15% of the Russian quoted FOB price

It is therefore not a surprise that the Armenian Railways claim that they can purchase - or have repaired - up to 95% of there spareparts and components for the rolling stock.

The Consultant was told that even large crankshafts for 10 cylinder diesel locomotives could be re-ground in Armenia and brake blocks, locally made, had been tested and accepted although the life time of the brake blocks was much shorter than the Russian made.

Meanwhile the Armenian Railways do not have sufficient funds to buy all the required spares and components but it is the Consultant's opinion that the local production should be encouraged, and by technical assistance, funded by the European Union, the quality and quantity of the domestic production could be improved eventually making it possible not only to supply the Armenian Railways with components but also at least the two other Caucasian countries.

The Armenian Railways (AR) will celebrate their 100 years anniversary this year in September, but due the de facto blockade of the country, and the break up of the former Soviet Union, the traffic has dropped dramatically resulting in a very poor state of the rolling stock and the permanent way including signalling and communications

As the railways are the only realistic transport mode for the most needed humanitarian aid to Armenia, the UN World Food Programme Organisation is assisting AR to some extent, but the assistance is meanwhile far from being large enough, and in a very short period of time it can be foreseen that the entire railway system will be brought to a standstill if no additional aid is allocated by other donor agencies.

It should be noted that the Armenian Government, albeit deciding the tariffs, in no way is subsidising the AR, leaving the railways to try to survive by the revenue from passenger and goods traffic.

The Consultant was told that approximately 60% of the revenue were spent on the purchasement of spareparts and consumables

Due to the rather autonomous state of the railways certain passenger services and kindergartens have been closed down without any interference from the government.

1.2 Railway network

Being a land-locked country Armenia heavily relies on the railways for the transportation of goods and passengers

The AR network consists of 845 km of single track (1520 mm gauge) except for the short Yerevan- Massis line which is double tracked

Branch lines totalling 210 km, are servicing industrial plants.

All lines including side lines are electrified (3000 V DC) and the network services 72 stations.

There are two main lines:

1. **Georgian border to the Naghitchevan enclave of Azerbaijan:**

   Airum-Vanadzor-Gioumri-Oktembri-Massis-Yerash-Veldagh

2. **Massis-Yerevan-Abovian-Razdan-Vardeniz-Zod (a gold mine district)**

At this line a branch at Razdan connects to the the Azerbaijan network at Akstafa, and from Gioumri a branch line reaches the border of Turkey at Ahurian

In addition three branch lines feed major industrial sites:

- Gioumri-Maralik
- Oktembri-Arsaluis
- Massis-Karmirblur

In many parts of the country the permanent way will have to negotiate mountainous terrain requiring sharp bends with minimum radii down to 150 m and gradients a steep as 38 o/oo at a length of 18 km.

Going down the slopes the electric locomotives are feeding electrical power back to the line to assist the braking, but the inverts need to be up-graded (or new technology introduced) to improve the system.

Most of the sleepers are made of impregnated wood, and in particular at the sharp bends the rails are now loose.

As a result severe speed limits are enforced and on some stretches the maximum speed is reduced to 15 km/h.

Max speed: 74 KPH (it was formerly 100 KPH for passenger traffic and 80 KPH for freight trains).

Nos of stations: 72

Nos of tunnels and bridges: not disclosed.

1.3 Organisation of the Armenian railways

The number of employees has dropped form 18.000 to 6.100 mainly due to a strict reduncancy programme, but also because many experts and skilled staff have left the Railways to seek better paid jobs.

1.4 Traffic

Due to the break-up from the former Soviet Union and the by the blockade of Armenia by neighbouring countries the goods traffic has dropped significantly, and passenger traffic is more than half during the passed seven to eight years as shown in the following table:

Year	Mill. tons km	Mill. tons	Mill. Passenger km
1988	4803		351
1989	5120		320
1990	4884	37.6	259
1991	4179	29.1	285
1992	1280	7.5	381
1993	450	2.6	142
1994	N/A	N/A	N/A
1995	402	N/A	166

In 1993 the rail transport share was approximately 75% of the total haulage of goods.

The drop in passenger traffic might in the future be more pronounced as certain passenger lines are closed down due to lack of rolling stock and/or a poor revenue.

2. Rolling stock

2.1 Locomotives

In total AR has 74 electric locos type VL 8 and VL 10 (4200 kW and 5500 kW) out of which 46 are in operation

Most of the electric locos are 30 to 40 years old, the newest ones from 1972.

The diesel locomotive fleet consists of TEM 3 (1200 HP) and M-62 (4000 HP), totalling 75 locos out which 11 are in working condition.

The diesel locos are normally used as shunters

The TEM 3 are from the 1960-ies while the youngest M-62 are from 1988.

All of the locos are more than 10 years overdue capital repair and the sick-line locos need a comprehensive re-habilitation as many of them have been cannibalised.

2.2 EMUs

The Electric Motor Unit fleet, built in the Baltic states, consists of 89 vehicles out of which 28 are in operation

2.3 Coaches

AR have 298 coaches of various types, out of which 134 are in traffic.

Approximately 100 coaches need a capital repair and 64 vehicles need a depot repair.

2.4 Freight Wagons

The total number of wagons is 4835, but only 1250 wagons are presently in operation.

3. Maintenance of the rolling stock

The total number of employees for the maintenance of the rolling stock is 1157 including drivers and drivers' assistants

According to the information obtained the yearly costs of maintenance are the equivalent of USD 516,000, but even if the average monthly salary is said to be USD 20, the maintenance costs seem to be highly underestimated

AR are still trying to following the standards and procedures for the running maintenance of the rolling stock as laid down by the former Soviet Union, but it is clear that the in-sufficient number of spareparts and other components is a very serious constraint

Capital repairs, previously carried out outside Armenia, are now long overdue and cannot be done due to the blockade

AR are trying hard to keep the overrun vehicles in traffic by repairing the most pressing items, but again lack of spares makes these efforts more and more difficult

Some of the spareparts are manufactured within Armenia, but are often of dubious quality, and the revenue from the railways is not large enough to provide for the domestic manufactured components.

The access to spares for the rolling stock from sick-lined vehicles by cannibalisation is almost exhausted and it is thus only a question of time before the entire fleet is brought to a standstill

On top of that the machine park at the AR depots for the repair and manufacture of components and spareparts has almost reached its technical life time and many of the tool machines are out of order either due to age or lack of spares.

3.1 Maintenance procedures

As aforementioned the Armenian Railways are following the rules and regulations as laid down by the former Soviet Union.

Due to the present constraints it is not entirely possible to carry out all the preventive maintenance and in particular for the locomotives it is fatal that all the locomotives are more than ten years overdue the capital repairs

3.2 Maintenance facilities

The maintenance of the AR rolling stock is located in two districts, Yerevan and Gioumri:

Yerevan depots:

electrical and diesel locomotives, EMUs

passenger coaches and freight wagons

Gioumri depots:

electrical and diesel locomotives, EMUs

freight wagons

3.2.1 YEREVAN depots

3.2.1.1 Coach and Wagon Depot

As the freight wagon depot was ruined by the 1988 earthquake, both wagons and coaches are maintained in the same depot, built in 1978.

The capacity of the depot is geared to maintain 300 wagons and 200 coaches per year, but as mentioned afore practically all of the machine park need to be renewed.

As an example can be mentioned that the welding equipment is manufactured back in 1978.

One of the newest machines the Polish wheel lathe (Rafamet) is from 1983, and will soon need a major overhaul.

Taking into consideration that lack of spareparts is a serious constraint the wagons look rather good whereas the passenger coaches are in a pitiful shape.

Windows are missing and the heating system is out of order making it a terrible experience to travel by train in winter time.

The brake blocks, manufactured locally, were said to be too soft i.e. the lifetime is very short.

The Consultant believes this is possibly caused by either a wrong content of Phosphorous or because Ferro-silicon is not used as an additive to the cast iron.

Rolling bearings are dismantled according to laid down rules, but no measurements are taken, and after cleaning and greasing the bearings are re-mounted on the wheels.

3.2.1.2 Locomotive Depot

The depot has three tracks for the maintenance of locomotives:

- EMU
- Diesel
- Electrical

The depot is very filthy with motors and other heavy components dumped in the pits.

Waste oil was evident all over the floors and in the pits.

Meanwhile the design of the work stations is good having lowered gangways along the tracks for better access to the inspection and maintenance of the undercarriage of the vehicles.

As a sign of the workers still possess there artisan skills an old steam locomotive has been very well rehabilitated for the 100th years anniversary.

The workshops for the repair of speed-o-meters and recorders and the test stand for the brake system are in good working order and looked neat and tidy but only little work was carried out in the workshops.

To maintain the wheels by re-profiling a Polish under floor wheel lathe had been installed in 1986 and was in working condition.

It was observed that in order to keep the correct thickness of the wheel flanges welding was applied.

The method is developed in Russia. and was claimed to have been used for many years, but in western Europe it is considered to be a very dangerous thing to do as the welding easily could dis-integrate from the flange causing a serious accident.

If welding of wheel flanges. meanwhile. is safe for slow mowing trains it is a cheap way of prolonging the life time of the wheels.

As maintenance and repair of electrical motors is not possible at the depot. continued operation of the locos relies on cannibalisation of sick-lined vehicles.

3.2.2 GIOUMRI depots

3.2.2.1 Freight Wagon Depot

The wagon depot is under construction and expected to be in operation beginning of August this year.

In the wagon shop there are two tracks. each with a length to allow for four to five wagons depending of the type of the wagons

Lifting gear and gantry crane have been installed. but the floor needed to be covered by a smooth layer of concrete

The bogie and wheel shop are allocated next to wagon shop to ensure short transport lines.

Provisions were made for cleaning of the bogies. but equipment is not yet installed.

A new Ukraine wheel lathe with under floor collection of swerve has been installed, but is not yet tested.

In addition the following workshops are almost ready for operation:

- Repair of automatic couplers
- Maintenance of brake systems
- Tool shop
- Repair of doors. panels. hatches etc.

Ventilation is not installed in any of the workshops. which will create problems when welding in the shops.

The capacity of the wagon depot is planned to be 3000 wagons per year. but due to the present situation only 1000 wagons will be maintained in the depot

Number of employees: 40.

3.2.2.2 Old locomotive depot

The old locomotive depot was built in 1953. but was damaged during the earthquake in 1988 to an extent that the building is in danger of a total collapse.

Design measurements have been taken to secure the building. but so far actual repairs of the cracked walls have not taken place

In the main shop there are three tracks with pits.

Components are scattered all over the place. and even in parts of the pits large motors are dumped.

The floors are covered with a thick layer of waste oil.

At one of the pits an under floor wheel lathe is positioned to profile the wheels whilst mounted on the locos.

In connection with the main locomotive shop the following workshops are situated:

- Electrical shop for re-winding of anchors and stators including varnish insulation and test of the finished motors

- The shop looks well organised and many motors were under repair, but it is difficult to obtain the right varnish for insulation. and the technicians are testing alternative products produced in Armenia.
- Machine shop where all machines. albeit very old. were in working condition.
- Workshop for compressors
- Workshop for brake systems
- Workshop for switch gear

All of the above mentioned shops were nice and tidy and most of the equipment in operation.

In a special workshop a new Russian welding equipment has recently been installed enabling welding of wheel flanges when they are worn thin

It is interesting to note that no problems have occurred with the welded wheels, which in western Europe is considered to be a very dangerous undertaking.

The wheels were mounted vertically on the welding equipment and pre-heated by welding gas.

There after a steel "tray" was positioned around the wheel to make provision for a layer of granulate fluss to be placed on top of the wheel flange

Then two electrodes were ignited making a welding seam on the flange while the electrodes were turned around the wheel

It was claimed that up to 8 welding seams could be placed on top of each other.

The welding slag was after the operation crushed and can be re-cycled up to three times as granulate fluss.

If this procedure of welding the wheels proves to be safe it is an excellent method to enlarge the life time of the wheels and should be introduced in rest of the CIS countries.

3.2.2.3 New Locomotive Depot

The new locomotive depot in Gioumri is not quite in the same state of completion as the new wagon depot, but the staff expected the depot to be in operation before the end of the year.

It is a rather large depot with tracks for 15 diesel and 10 electric locos. and in an additional shop there are two tracks for 12 EMU vehicles

It is planned that 10 to 15 capital repairs of mainline locos will be carried out per year, but the capacity of the new depot is probably around 100 capital repairs/year

4. Recommendations

4.1 Technical Assistance

Until such time the Armenian Railways will have to change to new technology (new rolling stock) they must use spare parts and components made according to the Eastern European standards and specifications.

As the revenue in forex will stay at a very low level in a foreseeable future, Armenian Railways will not be able to buy all of the required spares from abroad

It is therefore important that the domestic industry in Armenia receive technical assistance from the EU in order to improve the quality - and the quantity - of the locally made railway components.

A detailed study of the local industry is proposed to identify the most vital areas, where technical assistance could help improving the capabilities of the various plants

4.2 Re-organising of the Rolling Stock Maintenance

Like the rest of the CIS-railways the maintenance of the Rolling Stock is carried out in three "independent" departments. each of these taking care of the locos. the passenger coaches. and the freight wagons and with only very minute co-operation across the department boundaries.

The advantage is that the lines of communications within each department in theory are very short and the responsibility for the quality of each type of vehicle is well defined

This set-up of the maintenance organisation is meanwhile very costly in terms of investments as each department is self-sufficient concerning the machine park and the expertise.

In order to minimise the demand of re-investments in expensive equipment. and to make sure the remaining experts on special components are used in an optimal way it is therefore. proposed to gather as many common items as possible in one central workshop.

As examples can be mentioned a common workshop for maintaining bogies and wheels. a common workshop for the maintenance of the brake system. and a machine shop for the production and repair of components.

4.3 Introduction of Western European Roller Bearings

The presently used roller bearings for the rolling stock are of mediocre quality and demand excessive inspection and maintenance.

It is proposed to investigate if the journals of the wheel axles can be modified for FAG/SKF roller bearings.

Chapter 7 TURKMENISTAN Railways

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1. Overall

1.1 Background

Building of the Turkmenistan Railways (TDDY) commenced at end of the previous century.

The permanent way was built by Russian engineers and with the standard Russian gauge of 1520 mm and the total lenght of the network is 2.198 kms.

All the line is single track, most of the rails being R-65 type.

Max slope is 9 o/oo with a lenght of 300 to 350 metres.

There are two tunnels at the line with a lenght of 800 to 900 m.

Average distance between stations is 17-18 kms.

There are no electrified lines.

Maximum speed is 90 to 100 km/h, but due to a rapid deterioration of the tracks a lot of sections have speed limits at 40 and 60 km/h.

Before the break-up of the Sovjet Union the Railway was known to be highly reliable, and in 1990 the freight traffic reached a peak of approximately 55 bn ton-km

In 1994 the yearly hauled freight amounted to less than 50% (23.1 bn ton-kms).

The figures for 1995 was reported to be: **8.568 bn ton-km.**

According to the Central Asia Outline Transport Strategy Project the freight freight was as follows:

1993	19.4 bn ton-km
1992	22.9 -"-"-
1991	45.6 -"-"-
1990	47.9 -"-"-
1985	34.5 -"-"-
1980	29.1 -"-"-

A goods train would normally haul around 55 wagons, each of which is 60 tonnes loaded, or approximately 3000 tonnes per train.

As of May 15, 1996 an agreement has been made among the neighbouring countries that payments should be made in SFrcs. for goods wagons operating outside the home country as a first step to create a genuine pool of wagons for international traffic.

Mainly due to a very restricted policy of raising the tariffs for passenger transport the yearly traffic volume has been fairly stable throughout the past years at around 2.0 to 2.2 billion passenger-kms.

The average distance of a passenger is around 300 kms., and the ticket fare is 2,500 Manats or the equivalent of USD 0.8

In 1995 the transport of passengers has dropped to: **1.876 bn passenger-km.**

According to the same source as abovementioned for goods traffic the previous years data of passenger transport is as follows:

1993	2.200 bn passenger-km
1992	2.000 --"--"--
1991	N/A
1990	N/A

1985	1.700 bn passenger-km
1989	1.600 bn passenger-km

It was not possible to obtain any information of traffic costs and revenues.

1.2 Railways network

The railway network consists of the following lines:

The main line linking Krasnavodsk (Turkmenbazi)-Ashgebat-Mary- Chardev.

The other lines are as follows:

- a link with the Afghanistan border (Mary to Gyshgy)
- a link with Kazakhstan and Russia (Chardev-Darganata-Gazodjak-Dashhaouz)
  Part of the line is in transit through Uzbekistan
- a link with Uzbekistan (Chardev-Feder)
- a link from Uzbekistan to Tadjikistan is crossing Turkmenistan territory
- a link to Iran (Tedjen-Mashkhad)
  The line was inaugurated on Maj 13. 1996. and linked with the Iranian national railwys network. albeit at a different gauge. Turkmenistan has thus a direct line to the Gulf port of Iran at Bafq.

2. Rolling stock

2.1 Locomotives

2.1.1 Main line locomotives

BUILT - YEAR	2T3 10A	2T3 10B	2T3 10M	2T3 10Y	NOS.
1969	4				4
1970	38				38
1971	56				56
1972	13.5				13.5
1973	38 5				38.8
1974	12				12
1975	5				5
1976	11	3			14
1977	4				4
1980		1			1
1982			5		5
1983			1		1
1986			8		8
1993				33	33
Total	182	4	14	33	233

It should be noted that a TDDY loco in reality consists of **two** coupled 2 x three-axled locos each with a 10 cylinder two-stroke turbo charged diesel engine of 3000 HP.

Out of the 233 locos only approximately 120 are available for traffic

It was not possible to obtain data of which locos were out of traffic and for what reason.
It was claimed that between 110 and 150 mainline locos were required per day, but this figure seems to be exagerated compared to the traffic on offer.

TDDY insists on running with dual sets of locomotives even on passenger trains normally pulling 16 coaches.
One single locomotive(3000 HP) should easily be capaple of the haulage, but it is believed to have the redundancy as a safety factor should one of the locos break down on the line.

2.1.2 Shunting locomotives

BUILT - YEAR	T3M2	4M33	NOS
1970	1		1
1971	2		2
1977	1		1
1979	2		2
1980	2		2
1982		24	24
1983		41	41
1984		5	5
1985		10	10
1986		1	1
1987		6	6
1988		1	1
1989		1	1
1990		1	1
TOTAL	8	90	98

Out of the 98 shunters only 60 are in service.

It was not possible to obtain data of which shunters were out of traffic and for what reason.

2.2 Passenger coaches

Fleet:

Type	No. of vehicles
I Class	
Ritz 18 seats and sleeper	7
Sleeping cars 18 seats	8
Mixed 18 seats	9
II Class	
Two-level 54 seats	154
Half compartment	147
Inter regional 63 seats	38
Restaurant cars	17
Luggage	7
Special	4
Diesel electric van	2
Technical	8
Total	**401**

A figure was given of 270 to 280 coaches available for traffic at present.
It was not possible to get exact data on which types of coaches are available, but the so-called mixed coaches and restaurant and buffet cars have been withdrawn from service.

2.3 Freight wagons

Fleet:

Type	No. of vehicles
Covered	2856
Platform	3253
High sided open	2118
Tank wagons	2753
Cement	248
Container flats	257
Wheat silo	476
Refrigirators	700
Others	173
Total	**12814**

Except for the tank wagons, which are manufactured in Ukraine, the remaining wagons are made in Russia.

In addition to the above mentioned wagons other ministeries own 2.328 wagons of which 1184 are tank wagons.

3. Maintenance of rolling stock

3.1 General observations

Each type of rolling stock (locos, shunters, wagons, and passenger coaches) will be dealt with in detail later in this report, but here are some general observations of the present maintenance situation:

3.1.1 Fleet

Having a larger stock of vehicles than actually required by the traffic at hand the railways seem to be capable to cope.

In general the fleet in service seems to fulfil its purpose, but it should be borne in mind that the requirements have dropped significantly after the demise of the Sovjet Union, and the availability of the fleet has in the same time dropped to approximately 50% of what it was at the time of pre-independence.

3.1.2 Maintenance set-up

Each type of vehicle has its own maintenance organisation with the inherent facilities.
Only very little co-operation seems to take place between say a depot for locos and a depot for passenger coaches
Typically each of the major depots will have its own wheel lathes, bearing shop, and workshops for repair of components or spareparts which in fact are more ore less identical.

This is, of course a very expensive way to maintain a fleet, and in addition specialists on for example brake systems are spread over three workshops

It will later in this report be proposed that identical technologies should be gathered in one back shop (Central workshop) to minimize future investments in new machinery and equipment, and last not least unite the specialist for the various tasks.

This will, of course, in turn call for an improved production planning and quality assurance, both of which are virtually non-existent at present.

It should also be mentioned that protection of the environment seems to be very minute i.e. no collection or waste lube oil, no cleaning of welding gas fumes or diesel engine exhausts etc. etc., and in no of the depots visited nobody was wearing personal protection gear (Hard hats, hearing protection, or safety shoes).

3.1.3 Spareparts

The overall problem for the Turkmenistan Railway maintenance organisation is lack of funds to purchase spareparts
Components and replacement parts would normally be bought in Russia or in Ukraine, paid in US dollars, but an unsufficient amount of foreign currency is allocated by the Turkmenistan Government
Major overhauls have likewise usually been carried out in Russsia or Ukraine, but again lack of funds have made this almost impossible.
The last time a major overhaul of lococmotives took place was in 1993, and only for 33 locos.

This situation of practically no funds for spareparts is further worsened by the fact that tariffs, set by the government, are far from covering even the direct costs of operating the trains

A ticket from Ashgebat to Krasnavodsk (Appr. 500 kms.) is less than USD 2!

In order to keep the fleet running the maintenance organisation is forced to use spareparts from the rolling stock now out of service due to defective parts and the fact that there is an excessive number of locomotives and wagons compared to the transport of goods on offer.

3.1.4 Maintenance Staff

At present there are 6.864 employed at the maintenance organisation

Loco maintenance :3351 employees
Passenger coaches : 1781 -- --
Freight wagons : 1372 -- --

Breakdown of staff

		Loco drivers	Ass. loco drivers	Loco maintenance staff
ASHGABAD	Major over-haul & Back Shop	130	69	186
	Running depots			16
CHARJEV	Running maint depot (Two)	251	221	587
MARI	Running maint. depot	190	130	439
GAZADJIK	Running maint. depot	89	74	110
KRASNAVODSK	Running maint. depot	22	15	35
TOTAL		**682**	**509**	**1,373**

Total costs of maintenance in 1995 was reported to amount to:
4.1 bn Manats

Labour 1.30 bn Manats
Spareparts .0.50 bn Manats

From visits to the depots in Asgebat it is clear that the working force is well skilled and capable of doing small miracles to keep a fairly large part of the rolling stock in traffic, but also for the machinery and other equipment lack of spareparts is evident, and a large part of the machine park needs replacements.

Trains in the former Sovjet Union had a high reputation of reliability, which proves an efficient preventive maintenance but
without any data of MTBF and a detailed knowledge of the quality of the various components it is difficult to judge whether the maintenance procedures lead to over-maintenance.

It seems that replacement of diesel engines after 600.000 kms it a very short interval, and the roller bearings are obviously a weak point requiring a lot of checking and maintenance

The maintenance and repair of the rolling stock by "cannibalizing" can presumably continue for a short period of time but the fleet is definitely going to deteriorate in the long run without having new spare parts to replace defective components, and it goes witout saying that general overhauls must take place before it is too late -or too costly to renovate the fleet

As a result a large percentage of the fleet is now out of service for various reasons, and it could be feared that it will be impossible to keep the required number of vehicles in traffic, if the present situation with lack of spares continues.

Generally speaking the maintenance organisation is heavily over-staffed, but a considerable part of the staff seems to be semi-skilled workers.

Meanwhile the core of the staff will, no doubt, be capable of adapting new technologies, and practically all the engineers seems to be very dedicated on their jobs.

Given sufficient spareparts were available and key machinery was renewed, the maintenance organisation is geared to keep the rolling stock in a very good shape.

3.1.5 Other observations

A general "consultant-fatique" seems to prevail.
The staff was often heard saying: "It is good and well you are coming to visit us, but several consultants have been here before, and when do we see any results in terms of aid and assistance?"

Mr Yasberdiev noted that it would have been a big advantage if the TOR had been translated to Russian as only very few of the railway staff understand English.

It has not been possible to identify any company in Turkmenistan which could produce spareparts for the railways.

The Turkmenian industry is characterized as either light manufacturing such as shoes and kitchen utilities, or cement and brick works.

3.2 Locomotive maintenance

Due to the present situation where it is extremely difficult to obtain the spareparts from abroad the schedules for preventive maintenance have been changed from the original (Russian system).
Nevertheless the period of time between overhauls has been extended for more than 80% of the locos.

Most of the spareparts required are taken from locos out of service.
At the visit at the Asgebat depot defective windings on traction motor armatures were replaced with good windings from another defective motor.
It was claimed that the depot even was capable of repairing crank axles by hand-polishing(!)

3.2.1 Present Maintenance Procedures

	Inspections
TO1	Check by loco driver
TO2	Inspection every 48 hrs (at all depots)
TO3	Monthly inspection Change of filters and oil Lubrication Contactors and relays

	Light Maintenance - Servicing
TR1	Quarterly (or 45.000 kms) maintenance Turbo charger Cardan axle Fuel injection pumps Auxilliary equipment
TR3	600.000 kms maintenance Bogies removed and checked Diesel engine replaced Brake system serviced Wheels and running gear

These maintenance schedules are changed from the original Russian procedures as the intervals between preventive maintenance have prolonged

The reasons given for the change of schedules were lack of spareparts.

In 1995 only 41.5 locos received a TR3 maintenance compared to 128 locos in 1992.

The overhauls of locomotives used to take place in either Ukraine or Russia, but due to restrictions on the allocation of sufficient foreign currency the last time major overhauls took place was in 1993 and only covering 33 locos

TDDY had recently asked for a quotation on a capital overhaul in Russia, and the price quoted was USD 61.830 which is considered to be a very high price

3.2.2 Locomotives Maintenance Facilities

TDDY has the following depots for maintenance of locos:

3.2.2.1 Ashgebat : Overhaul and heav repair depot

TR3 maintenance of all locos
Back shops for component repair

Nos of employees

-	locodrivers	130
-	ass. locodrivers	69
-	loco repair	186
-	fitters	37
-	others	400
	Total	822

3.2.2.2 Ashgebat : Running maintenance depot

Nos. of employees 16

3.2.3 Charjev : Running maintenance depots

(two depots at Charjev I station and Charjev II station)

Nos of employees

-loco drivers	251
-ass loco drivers	221
-maintenance	587

3.2.4 Mari : Running maintenance depot

Nos. of employees:

- locodrivers 190
- ass. loco drivers 130

- Running maintenance depot Krasnavodsk
- Running maintenance depots (2) Charjev

3.2.5 Ashgbad Depot for Major Maintenance

The depot, built in 1934, is very old and worn down.
When supplies of spare parts were adequate the works manager claimed that they could carry ot 32 to 34 TR3 per month.
Presently approximately 200 people are employed at the depot.

Main shop

The depot consists of a workshop for locomotive maintenance having lifting jacks and a conveyor in the floor for moving the bogies.

Back shops

The backshops are mainly:

Plast moulding shop where all kinds of plast parts are made.
The moulds and the equipment were all made locally at the workshop.

Repair shops for bearings, cylinders and motors.
The w/s is capable of renewing the bearing metal and to make new bearings out of metal swarf.
Honing of cylinders
A standard machine shop with a series of traditional lathes, milling machines etc. Very old machine park, but many of the lathes were actually working.

Wheel shop

In the wheel shop there were to wheel lathes (one very old one and beyond repair) and a 15 years old Polish wheel lathe in good working condition, but only capable of turning about six new wheels per day.
Vertical lathe for tyres
Gas heater for tyres and a very old rolling machine.

General overhaul of engines must go to Tashkent or Ukraine but TDDY claimed they could repair
bogies
turbo compressors
traction motors
fuel injection pumps
governors
brake shoe manufactoring by cupola ovens

Cost of major overhauls: 60% for transport - 40% for overhaul
40% of all spare parts can be repaired at the W/S
generators normally did not break down

3.3 Coach maintenance

3.3.1 Coach Maintenance Procedures

As for the rest of the fleet the main concern was lack of spareparts, in particular spares for the electrical system, the air conditioning and the brake system.

It was claimed that 14 passenger trains are running per day carrying 17.000 passengers.

At the Asgebat Central Railway Station it was noted that eight trains were leaving and eight trains were arriving every day according to the time table.

The yearly traffic was estimated to six million passenger.

A new Russian coach is estimated to approximately USD 250.000

A ticket from Ashchabat to Krasnavodsk (500 km) costs 6.700 manats or around USD 2.00

3.3.2 Coach Maintenance Facilities

Ashgebat

- Running maintenance depot
- Maintenance depot and back shop

Charjev

- Running maintenance depot

The passenger coach depots are situated close to the loco depots.

The running maintenance depot in Ashgebat has one track with space for two coaches.
The track has two sets of electrical lifting jacks and a gantry cranes to lift the bogies to second track for bogie inspection.

The maintenance depot has two tracks with lifting jacks for four wagons.
Two gantry cranes for lifting the bogies to a third track for bogie repair.

Machine shop with standard lathes, drilling machines etc.

Wheel shop with two wheel lathes made in Poland in 1989.
Ten wheel sets can be profiled per day.
The wheels are without tyres.

Test gear for detection of cracks on wheels.

It seems to be a major task to maintain the roller bearings as there were bearing parts all over the place at the roller bearing shop.

It was claimed that the back shop was capable of repairing shock absorbers, but I did not see any facilities for that.

In addition to the depots there is a washing plant which is partly out of function and a shed where painting of the coaches can take place.

Worn-out brake blocks are sent to Russia and in return new ones are purchased.

3.4 Wagon maintenance

3.4.1 Wagon Maintenance Procedures

The in-coming train inspection relies very much on a detector, placed 3 to 4 kms before the station.
The detector is checking on both sides of the train if a wagon has a hot box and it can even detect if some of the brake gear is dragging below a wagon.
If a hot box occurs, a signal is automatically sent to the station indicating which wagon is defective.

TDDY has at present 25 detectors, but are installing more.

3.4.2 Remarks on wagon maintenance

Number of break-downs per year	N/A
Availability of wagons	N/A

It was mentioned that as per Maj 15, 1996 a new system will be introduced for wagons crossing the borders.
A fee will be received from the foreign country (in Swiss Frs.) depending on how many days the wagon is in traffic in the country

From other sources it was learned that TDDY was not happy to let their wagons go abroad as they always received the wagons in a very poor state.

3.4.3 Wagons Maintenance Facilities

TDDY has four wagon depots for maintenance/light repair and one wagon shop for overhaul/heavy repair.

The depots are situated in

Krasnavodsk
Mary
Charjev
Ennjev

and the wagon shop is placed in Kisilavatj.
The wagon shop is presently undergoing a major reconstruction.

4. Transport and Communication Institute

The TDDY has its own Railway College where fitters, loco drivers etc. are trained.

For further education The Transport and Communication Institute was built three years ago.

It covers more than 20 areas of training within transportation, goods handling, and communications.

At present there are 1400 students at the institute. 140 full time teachers, and 300 part time teachers.

For the railways there are presently 250 students to be trained as rolling stock engineers, permanent way engineers, goods handling, signaling & communications, and transport economics.
In addition some training was given in English.
It was claimed that 30 students could speak English.

The students have access to personal computers, donated by a Turkish company, and Alcatel has donated a signalling system for training purpose

The library contains more 100.000 volumes, and the Ministry of Transport has recently spent USD 50,000 for the purchase of additional 3000 books.

The students graduate after four years having spent some of the time on practical jobs at the railways.

All the students are from Turmenistan, but it was not excluded that foreign students could be matriculated at a later state

There is a close contact with the Russian Transport Institute to ensure an up-dated curricullum.

5. Recommendations

CENSUS OF ROLLING STOCK
INCLUDING REASONS FOR THE VEHICLES BEING SICK-LINED

TDDY does not have a proper controle of the rolling stocks in terms of availability of the various types of vehicles i e locos, shunters, freight wagons, and coaches.

It is therefore, proposed that a comprehensive census should take place as soon as possible, with the following information as a result

- vehicles fit for traffic
- type of vehicle
- identification number
- allocation

- vehicles out of service
- type of vehicle
- identification number
- allocation
- reasons for being sick-lined

The compiled information should be constantly up-dated in future as a valuable instrument for the traffic service. and an important input for the repair depots enabling them to establish a priority of repairs including required components and spareparts

SPAREPARTS
The biggest constraint for the maintenance organisation is lack of funds for the import of spares and components. In an effort to keep the required numbers of vehicles in traffic sick-lined vehicles are cannibalised to recover useable spareparts

As afore mentioned this procedure is only feasible for a short period of time.

Based on the information obtained from the census and other available data a list of required spareparts should be compiled

KEY MACHINES

Albeit the average age of the TDDY machine park is not considerably high many of the key machines and other equipment is badly in need of repair

It is proposed to carry out a detailed study of which machines require maintenance and spareparts. and which machines need to be replaced

RE-ARRANGEMENT OF MAINTENANCE SET-UP

The set-up of the various depots as self-reliant entities could be said to be very efficient as the authority and responsiblitity of the staff in charge is well defined

As each repair depot has its own workshops the commando lines are very short. and changes of the production plans can be carried out at a short notice.

Meanwhile this arrangement is very costly in terms of investments in machinery and eqipment. and the expertise of special technologies
is diluted throughout the maintenance organisation

It is. therefore. proposed that a common workshop should be established with special workshops for wheels bearings motors. electrical components. foundry shop for brake shoes. etc. etc.

This would minimize the costs of future investments and concentrate the various experts within TDDY.

In turn the new organisation of the components manufacturing and repair would call for a much improved production planning and the introduction of a quality assurance department

IMPROVE DATA COLLECTION AND ANALASYS METHODS

No modern and efficient maintenance organisation can work properly unless a comprehensive data system for the rolling stock is available giving information of the status of each individual vehicle such as:

- last preventive maintenance
- repairs carried out
- components replaced
- MTBF

As TDDY at present only collect very few data of thhe above mentioned character it is. therefore. proposed that each service should have its own data system on personal computers.

At a later stage this system could easily be enlarged to monitoring of costs and spareparts inventory.

TURN ASHGEBAT DEPOT INTO PLANT FOR CAPITAL OVERHAUL/HEAVY REPAIR

The last major overhauls of lococmotives took place back in 1993. and because of lack of foreign currency no further major overhauls are planned in the near future

If the proposed re-arrangement of the maintenance procedures is carried out. the Ashgebad loco depot could fairly easy be turned into a capital repair entity for locomotives with sufficient capacity for all TDDY locos and the locos in the four neighbouring states

IMPROVE ENVIRONMENT PROTECTION

Very little is done to protect the environment

Waste oil and solvents are sent directly to the sewage system and in many of the shops the floors are covered by a thick layer of oil

Ventilation systems with a proper cleaning of hazardous fumes from welding etc. are non-existing.

As part of the rehabilitation of the workshop the issue of protection of the environment should be integrated.

IMPROVE OCCUPATIONAL HEALTH AND SAFETY (OHS)

Although TDDY has its own doctors and nurses to take care of the staff next to nothing is done to prevent occupational hazards

Hard hats. eye- and hearing protection. safe-guard shoes etc. are never seen being used by the maintenance staff
Welding is taking place with-out proper ventilation. and in some of the workshops the noise is at a level which prevent conversation even with a loud voice.

A supply of personal protection gear and training of the staff in OHS should be part of the future assistance to TDDY

Chapter 8 KYRGHYZSTAN Railways

Table of contents

1. Overall

1.1 Infrastructure

Length of the network is 423.9 km. only single track. 322.7 km in the Nothern part of Kirgistan and 101.2 km in the Southern part. The track gauge is 1520 mm and the average distance between two stations is 15 km. There was no information available concerning profile (secret) and tunnels they do not have. They have 148 bridges (two of metal and the rest cement/blocks/stones).

40°₀ of the main lines are made of rail R65 (65 kg/m). 5°₀ are made of R43 and the rest are made of R50. They have 230 km side lines (R43/R50)

20 km of the main lines are whole-welded on concrete sleepers and the rest are bolted joints (25 m) on wood sleepers

Minimum curve radius..300 m

Maximum slope and lenght
North 20°₀
South 37°₀
Lenght about 10 km

Signal system
The line between Bishkek and Balakti has automatic blocks the rest of the lines have half automatic blocks. All stations are electrical controlled ecxept of five which are manual controlled. They have radio communication between their locomotives and the stations

1.2 Management organisation

Kirgistan railways is divided into two geographical regions without directly railway connection inside Kirgistan

1 North the line from Kazakstan border to Balakti

2 South Osh - Djalal Abad

1.3 Traffic and train operation

1.3.1 Transport information:

Freight loading/unloading is possible on 25 stations in Kirgistan

Temporary storing of freight is not on the responsibility of the Kirgistan Railways. Clients are responsible for the storing of freight

Loading of 20-feet containers is possible on four stations

In 1995 they produced 30.2 mil pass Km. hereof 20°₀ domestic and 402.6 mil ton km of freight, hereof 98% abroad

Quantity of freight transported in 1995

Type	1000 ton
Grain and bread products	233
Coal	932
Oil and oil products	862
Black metal	71
Wood	43
Chemicals	32
Construction materials	149
Cement	187
Cotton and other things	18

1.3.2 Operation features

Delays and accidents from 1992 - 1995

Type	1995
Serious accidents (deathly)	0
Materiel damage	20
Train crash	-
Derailments	7
Delays more than 1 hour	7
In general	-

They have a daily follow-up system concerning all incidents during 24 hours, but they could not give me a statistical overall view of the operation pattern within the time available during the visit.

Rolling stock km production 1995:
Locomotives 2.000.000 km
Passenger wagons 7.006.000 km
Freight wagons 13.416.000 km

1.3.3 Operation organisation

The superior management of train operation is made by the main operation centre in Bishkek. Some lines are provided with auto-block signal systems and some stations are fully automatic.

Maximum train speed:
passenger.....100 km/h.
freight..... 80 km/h.

Average distance between two stations is 15 km and average running time for a train between two basic stations is 4-6 hours.

Weight of an average freight train is 3500 - 5000 ton. The weight of an average freight wagon is about 22 ton and they can load 65 - 70 ton each. The maximum number of freight wagons in a train is 52 due to the construction of stations.

Average number of train in operation per day:
passenger 7
freight 3

Railway education system:
They have a education sytem within the railway for all their specialists. Education on a high level they have to use Almati or the Technical Institute in Bishkek

1.3.4 Economical results of operation

Economical information 1995 (mil som)

	Passenger	Freight	Total
Income	59.4	98.4	157.8
costs	87.7	52.8	140.5
Total	-28.3	45.6	17.3

2. Rolling stock

2.1 General

All freight wagons are from Russia, except for the refrigerator wagons which are from Germany.
All locomotives are from Russia, except for shunting locomotives ChE3 which are from Czechoslovakia.

There is one workshop for locomotive maintenance , one workshop for passenger wagons maintenance and one workshop for freight wagons maintenance all located in Bishkek.

2.2 Fleet of rolling stock

April 96 data

2.2.1 Diesel locomotives

Type of service	Type of locomotive	Quantity of locomotives	Quantity of units
Long distance	3TE10M	3	9
operation	2TE10L	11	22
	2TE10V	17	34
	2TE10M	3	6
Total		34	71
Shunting	TEM2	14	14
	ChME3	9	9
Total		23	23
Total		**57**	**94**

Age of the fleet

Type	Quantity	Year of construction
3TE10M	3	1983
2TE10L	11	1970-1976
2TE10V	17	1977-1980
2TE10M	3	1981-1982
TEM2	14	1969-1986
ChME3	9	1988-1990
Total	57	

They could not afford to divide the age of locomotives into groups during the time available for the visit

They have no locomotives out of order, but 70% of the locomotives are over-ran (maintenance km).
No figures of scrapped locomotives but they have crapped a certain numbers and reused vital spare parts to keep the existing fleet in operation.

2.2.2 Passenger coaches

They have two main types of wagons, sitting and sleeping wagons. The origin of sleeping wagons is Germany (Amendorff) and sitting wagons Russia (Tver).
There are about 79 wagons out of order due to the age (more than 28 years). The total amount of wagons is 529 wagons

Schema concerning the age of the passenger wagons fleet, planned years of operation is 28 years.

Year	SV	TSMK	TSMO	MObl	P/V	VR	Other	Total	%
1950-59							1		
1960-69		39	18	16	9	8	3		
1970-79		49	153		11	9	1		
1980-89	9	46	110			12			
1990-95		18	15			2			
Total	9	152	296	16	20	31	5	529	

Characteristics

SV = double sleeping room (new type)
TSMK = sleeping wagon with four places
TSMO = one room wagon
Mobl = Wagons for domestic traffic (sitting)
P/V = post and baggage wagons
VR = restaurant wagons
Other = service/technical wagons incl generators and prisoner transportation

In 1995 the wagons produced 91.3 mil wagon km and in the 1. quarter of 1996 they have produced 18.1 wagon km

Condition of fleet
79 wagons are out of order due to the high age (more than 28 years) and the rest need maintenance. they have just scrapped 21 wagons to get some spare parts and have planed to scrap further 40 wagons.

2.2.3 Freight wagons

Amount of wagons and their age:

Type	19??-1969	1970-79	1980-89	1990-95	Total
KR, closed	182	296	180	24	682
PL, platform	101	225	135	18	479
PV, open	93	276	275	44	688
TsS, tank	69	91	85	6	251
Other, mixed	80	99	306	31	516
Total	525	987	981	123	2616

Included in Other they have 58 container wagons (avarage age 26 years). 727 wagons are out of order as they do not need them at the moment with the present freight volume to transport on the railways.

By the end of May they are going to count all wagons within Kirgistan to make a status. they have 105 wagons from other countries located in Kirgistan at the moment.

3. Maintenance

3.1 General management

Each workshop has its own bank account and the manager of the workshop is responsible for the account (budget and legal use) to the Railway Director.

Changes of technical rules/descriptions concerning maintenance of the rolling stock can only be done by the Ministry of Transport.

Each workshop has its own follow-up system on production/economy and they make quarterly reports to the railway management.

Reports from current staff in operation are forwarded to the respective workshop management for further treatment.

Railway organisation and organisation of the workshops are enclosed as following:

3.2 Organisation

Description of the scheduled maintenance system of the rolling stock

3.2.1 Diesel Locomotives

Long distance operation

Type of inspection/maintenance	Frequency	Comments
TO-1	Daily control	made by engine driver
TO-2	36-hours	workshop, Bishkek
TO-3	7500 km	workshop, Bishkek
TR-1	30000 km/2 months	workshop, Bishkek
TR-2	120000 km/8 months	workshop, Bishkek
TR-3	240000 km/1.5 years	Kazakstan, Chu
KR-1	720000 km/4 years	main workshop, Tashkent
KR-2	1440000 km/8 years	main workshop, Tashkent

Shunting locomotives

Type of inspection/maintenance	Frequency	Comments
TO-1	daily	made by engine driver
TO-2	weekly	workshop, Bishkek, Jalabab
TO-3	monthly	workshop, Bishkek, Andijan (Uzbek)
TR-1	every 7.5 months	workshop, Bishkek, Andijan

TR-2	1 year and 3 months	workshop, Bishkek, Andijan
TR-3	every 2 years and 6 months	workshop, Kazakstan/Andijan
KR-1	7,5 year	main workshop, Tashkent
KR-2	15 year	main workshop, Tashkent

Bishkek workshop is only able to carry out maintenance up to level TR-2 (included), TR-3, KR-1 KR-2 and replacing of wheel set they have to do abroad

Planned and realised maintenance production in 1996

Type of inspection/maintenance	**Planned 1996**	**Realised up to 15.05.1996**
TO-3	680	249
TR-1	40	20
TR-2	8	1
TR-3	8	3 (in Kazakstan)
KR-1	4	0
KR-2	4	0

The plan of maintenance of locomotives was made in accordance to the data of the existing fleet and the guidelines given from maintenance manuals and on a production of 1000 mil ton km (passenger 40% and freight 60%) for 1996

There are employed about 500 workers in the workshop

They have 12 locomotives in daily operation, each locomotive in 11 hours. The average km-production per loc per day is 654 km

Statisticly they have 66 unplanned repair per produced 1000000 locomotive km.

All machinery and equipment in the workshop is old and wheel turning they have to do in the freight wagon workshop

3.2.2 Passenger wagons

Maintenance system

Type of inspection	**period**	**planned production 1996**	**Realised 1. Quarter 1996**	**estimated costs (sum)**
TO-1	before operation			726/wagon
TO-2	summer/winter			
TO-3	6 months	13300	3311	9655800
DR	1 year			
KR-1	5 years	320	80	6280960
KR-2	20 years	10	3	8750000

All unexpected repairs are included in the above mentioned figures. They have a centralised registration of repair/maintenance for each wagon.

The workshop is also responsible for the maintenance of 24 refrigerator wagons.

Workshops where to carry out the maintenance:

Workshop/location	Type of inspection/maintenance
Bishkek	TO-1, TO-2, TO-3, DR, KR-1
Osh	TO-1
Jalabadad	TO-1
Kazakstan/Almati	KR-2

The workshop in Bishkek is divided into 3 parts:
1. Central workshop, all maintenance
2. Assempling place
3. Old agriculture machinery plant for roof and electrical repair

There are employed 2157 workers in the passenger wagon department.

3.2.3 Freight wagons

TO-1 and TO-2 inspection are carried out on all freight loading stations of which they have 25 in all Kirgistan. If damages appear which they can not repair locally, they have to send the wagon to Bishkek (workshop), Kant, Jalabadad or Osh (depots). Refrigerator wagons are maintained by the passenger wagon department. All cleanlyness of freight wagons has to be done in Bishkek.

Bigger repair and maintenance at level TR-1, DR and KR-2 has to be carried out in the main workshop in Bishkek.

The capacity in Kirgistan is 2000 current maint./year and 400 wagons/year for main maintenance (TR-1, DR and KR-2) and there are employed about 400 workers in the workshop.

In 1995 they carried out repair on 1050 wagons and 24 main maintenance.

The plan for 1996 concerns:

Type of repair/maintenance	Planned 1996	Realised up to 01.05.1996
Repair, unexpected	3531	1391
Current maint. TO-1, TO-2	1200	402
Main Maintenance: TR, DR, KR	50	20

They have a system concerning centralised information collection to secure a central overview of the present condition of each wagon. In 1995 they had 43 derailments.

3.3 New infrastructures

The Railway Administration conduct a programme concerning reconstruction of an old plant (building materials) in Belovodskoe to organise a new workshop for freight wagon maintenance. Capacity of the new workshop is planned to be 1000 wagons for current maintenance and 100 wagons for main maintenance per year

Furthermore they are constructing a paint workshop for passenger wagons and a widening of passenger wagons repair up to 480 wagons per year.

4. Procurement

Since the collaps of Former Soviet Union the prices of spare parts have increased extremely e.g. the price for one wheel set increased within a year from 3 mil roubles to 16 mil. Before 1991 Kirgistan had 58 plants and 46 factories. In 1996 there are only 2% left and the volume of freight decreased compared to this.

They are preparing a contract with former suppliers in Russia, based on "change services" to arrange the needed parts. They have local enterprises who co-ordinate arragements of spare parts from abroad.

They have problems with procurement of special steel e.g. to concrete sleepers as the russians consider this type of steel as strategical important

Locally they can procure sleepers (Grand interprise), brake blocks and rubber.

30% of the total budget is marked for purchasing of spare parts/material (25% abroad and 5% local).

Material costs 1995 planned and realised (1000 som)

Type	Locomotives	Freight wagons	Pass. wagons	Track maint.	Total
Fuel	16627	94	1860	685	19266
El. energy	140	74	203	159	576
Spare parts	3104	1515	11196	1216	17031
Sleepers, rail	-	-	-	3742	3742
Total	19871	1683	13259	5802	40615

Locomotives
Main problems with the locomotives concern wheels, electrical machinery, diesel motor (pistons and cranks) and bearings for pistons.

Less than 1% of the needed spare parts is possible to purchase locally.

Passenger wagons
Main supplier is Russia (Tver) delivery after payment, but at the moment they do not use them due to lack of money

The amount of money to procure materials and spare parts to maintain the wagon fleet is approx. 9 mil som (1996), of which they spend 80% on local suppliers. The local suppliers get their components from abroad. They need to procure: wheels, couples, bogies, parts to the brake system, gear boxes, absorbers, electrical system (generators, relays, batteries etc.) and wood

Due to lack of spare parts they can not complete their planned maintenance program. They have to operate with wagons over-ran.

They have plans for:

- 1. Carry out a special rehabilitation program (KVR) for 15 of their wagons in Almati to prolonge their life about 20 years, the price will be about 350000 DM/wagon (+20% VAT) and to rehabilitate 30 wagons in Polen to a price of 225000 $/wagon. The contract with Polen include "change of goods" as legal payment.
- 2. Change wagon type TSMO to MObl , price 875000 som/wagon in Almati.
- 3. To construct a workshop for wagon painting in Bishkek
- 4. To make the existing workshop in Bishkek bigger.

The workshop need a new wheel lathe (under floor), machinery to dismantling of wheel sets, new lifts for wagon bodyes and covering of their workshop

They have forwarded a proposal concerning purchasement of new wagons as following:

Wagon type	1996	1997	1998	1999	2000	total
P/V				5	3	8
VR	5		2		5	12
TSMO	10	10	18	41	8	87
TSMK	20	20	2	19		61
Total	35	30	22	65	16	168

Freight wagons:
They can buy all spare parts in Russia (if they have money), 2-3% they can produce themselves in Kirgistan. Their main problem is supply of bogies as they can not produce them themselves.

5. Conclusions

Their workshops are functioning despite of old technology within some areas.

The logistical system could be better and they need to increase organisation and cleanliness within workshops visited

Undoubtedly they can execute all described maintenance tasks on all rolling stock, if they have access to spare parts, machinery and materials needed.

The efficiency and productivity could be higher

The main problem is that they do not have transportation enough to cover their need for procurement of needed spare parts and materials to the existing fleet of rolling stock.

Especially they need workshops to carry out main maintenance of all their types of rolling stock

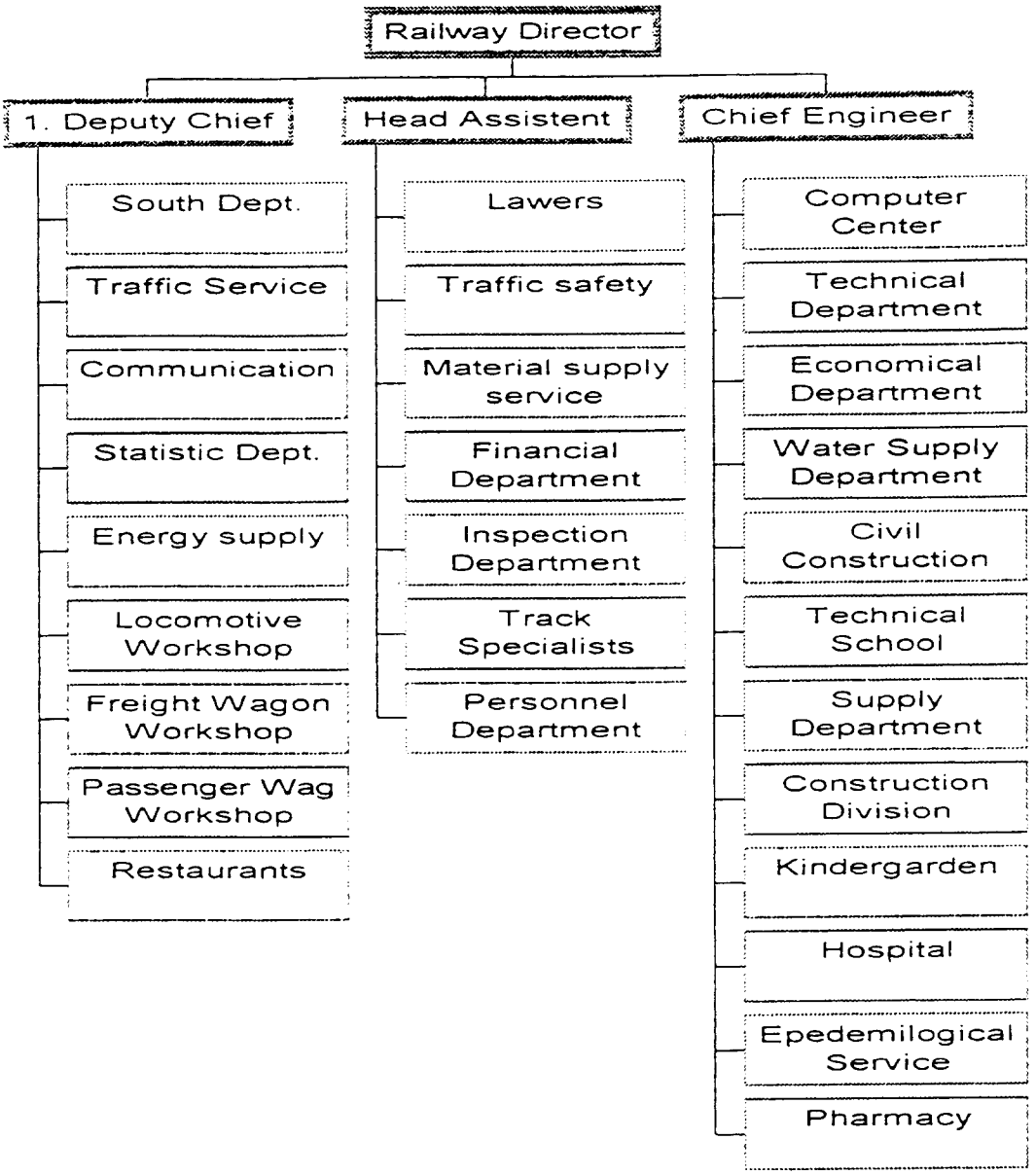
They need workshops (own or private) to produce/maintain different electrical/electronic equipment as generators, relays etc.

They could not document the amount of maintenance based upon realistic transport information

In generally they got maintenance descriptions and quality targets concerning all type of rolling stock, but the maintenance descriptions could undoubtedly be revised if the information concerning amount of repair/frequency was available in a proper way. this to increase efficiency and productivity.

As Kirgistan produce electrical energy it seems to be a good idea to invest in electrification of their main line in North.

Organisation of the Kirgistan Railways



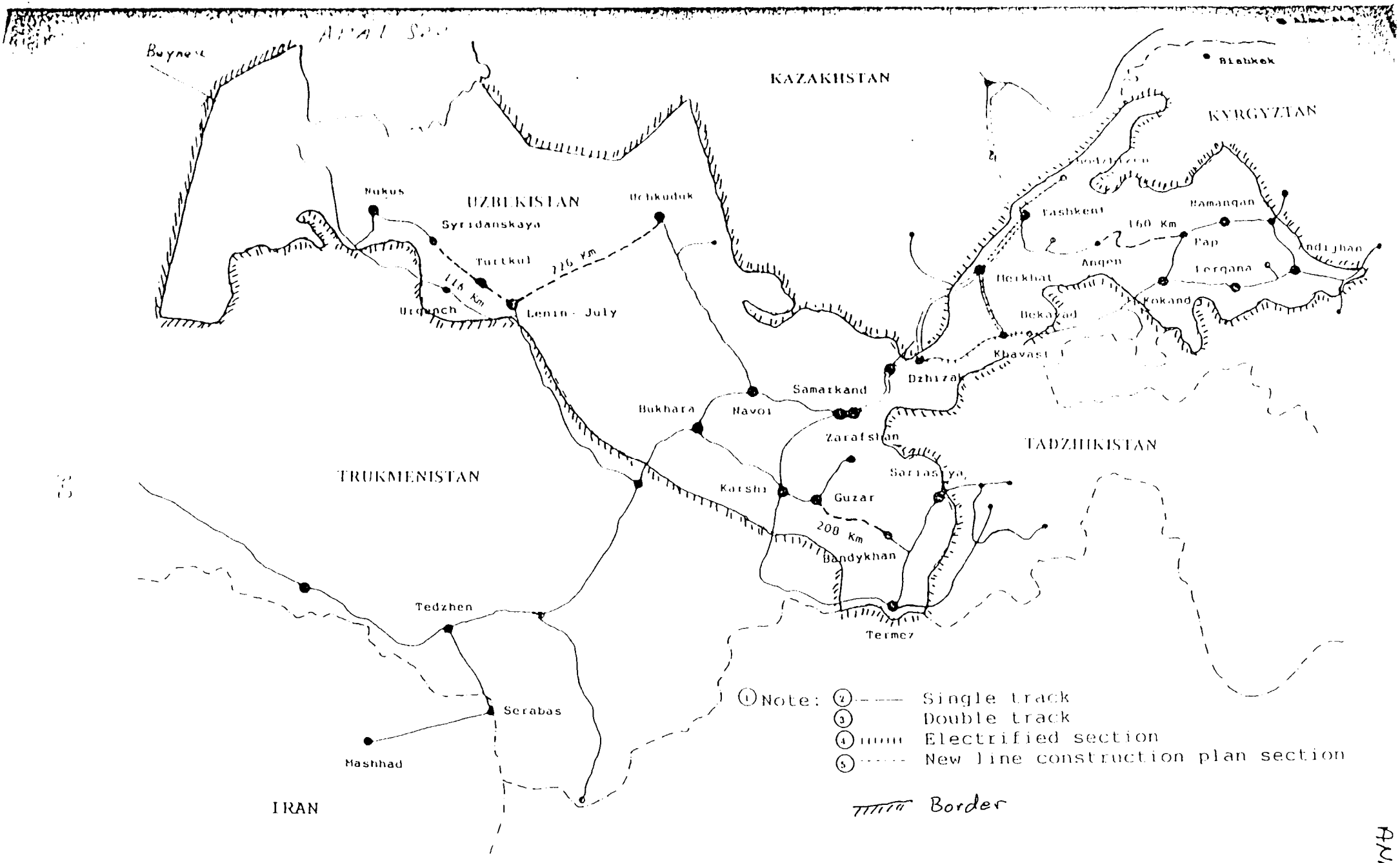


Fig. 3-1-1 Railway Route Map

ANNEX 4

Chapter 9 TADJIKISTAN Railways

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1. Overall

The Tajik Railways emerged as an independend entity as late as October 1st 1994, having been under Russian management since 1929 when the then Soviet Union engineers began building the network.

The network totals 423 km of single tracks of standard Russian gauge, but consists actually of three lines:

The Northern Line, connected to the Uzbekistan network at both ends, goes from Nau in the east via Hujang to Kanibadam
Lenght of line 110 km

The Central Line runs from Patahabad at the Usbek border via Dushanbe to Yangibazar.
Length of line 93 km

The Southern Line runs from Hashidy at the Usbek border via Kurkan-Tube to Vash.
Lenght of line 220 km

In order to go from the Central and Southern Lines to the Northern Line the trains have to pass through 700 km of the Usbekistan and Turkmenistan railway networks.

The TR network services a total of 29 railway stations.

Max slope of the TR tracks is 18 o/oo and there are no tunnels.
There is no electrification of the line.

The trains are running with an average speed of 60 km/h
Speed limits were not disclosed

Total nos of employees: approximately 7000

In 1995 TR carried the following traffic

- 123 8 mill passenger-km
- 2114 6 mill tonnes-km

No figures were given for previous years transport presumably because TR was then under Russian management

2. Rolling stock

2.1 Mainline locomotives

Main line locomotives

2501 - 3000 HP	4	
3000 HP	42	(dual sets)

2.2 Shunting locomotives

HP:	21
Average age of the locomotives:	17 years
Nos of locomotives 1001 - 1500 in operation:	41

2.3 Passenger coaches

Ritz 18 seats	10
compartment 36 seats	2
Platz cart 54 seats	139
compartment 36 seats	177
Restaurant car	14
open 84 seats	8
Luggage	1
Staff	4
Total	355

Nos of coaches in operation : N/A
Age distribution of coacehs : N/A

Average age of coaches was told to be: 22 years

On all windows of the coaches a frame with heavy mesh-wire was mounted as protection against rebel attacks.

2.4 Freight wagons

Covered	557
Platform	334
Open	619
Tank	21
Special	581
Total	2112 *)

It was later disclosed that TR recently had received 52 five-set used refrigirator wagons from Russia.
The five-set wagons consist of one wagon with refrigiration equipment which cools down the remaining four wagons.

Number of wagons in operation : N/A

Age distribution of wagons : N/A

Average age of wagons told to be 16 years

3. Maintenance of rolling stock

3.1 General Observations

TR follows the old maintenance system. adapted from the former Sovjet Union. as far as it is possible during the prevailing conditions of lack of funds to buy spareparts from abroad.

As observed in Turkmenistan the maintenance of the various types of the rolling stock are maintained by "independent" depots in the sense that there is no co-operation between the depots in terms of the repair of parts
As an example it can be mentioned that the depot for passenger coaches has an almost new wheel lathe which is only used for reprofiling of wheels for coaches. and it is only working in one shift.
Only the repair of couplers is centralized with one workshop for all vehicle couplers.

Total nos of employees at the maintenance organisation:

4963 (including loco drivers)

Maintenance of locos	555
Maintenance of coaches	1074
Maintenance of wagon	305

Maintenance costs (1995) in Tajik Roubles:

Rate of exchange May 1996: USD 1 = 260 Tajik Roubles

Total	751190
Labour	161640
Spare parts	59399

Because of the very high rate of inflation it is almost impossible to convert the figures to hard currency.

Due to lack of spareparts vehicles out of service were cannibalized for useable components and spares.
The work force seems to be adequate skilled for the jobs. but it was told that over one million people have left the country after the break-up of the former Sovjet Union. most of them highly skilled. and in the machine shop at the passenger depot all the tool machines stood idle due to lack of fitters

The maintenance staff has only little sense of data disciplines.

Important data such as MTBF was not available. and even hard pressed nobobody could tell the life time of wheels or how many hot boxes they had per year

The general conception is that if a component is defective it must be repaired. but no analysis seems to be carried out concerning the reason for the defect or how often this defect occurs per year.

It was not possible to identify any local industries which could assist TR in the manufacturing of spareparts.
It was said that not long ago a textile factory was used as a sub-supplier. but this factory was now closed down.

TR had tried to produce its own brake shoes. but it had failed due to poor quality of the local coals.

3.2 Maintenance of locomotives

3.2.1 Maintenance facilities

TR has three depots for locomotive maintenance:

- Dushanbe
- Kurgan-Turba
- Hugand (former Leninabad)

The depot in Hugand is not completed.

3.2.2 Dushanbe Loco Depot

The depot was originally built in 1929 in conjunction with the building of the railways, and both in 1966 and 1981 the dpot was enlarged.
In the depot there is space for 5 dual set locomotives, and workshops for the repair of:

- bogies
- bearings
- brake valves
- motors
- batteries
- machine shop

Two fairly old wheellathes were in operation, but a brand-new Russian underfloor wheellathe was purchased to be installed in Hugand.

On a load bank stationary tests of the locomotives could be carried out.

In general the machine park and the lifting jacks are very old and some of the tool machines require a comprehensive overhaul.

Probably due to lack of spareparts for locomotives a number of passenger coaches were undergoing repair in the depot.

3.3 Maintenance of coaches

Before winter and sommer begins, heating and air conditioning are undergoing a major inspection, but it was claimed that TR had no facilities for the repair of the air conditioning systems.

16 coaches had a KR1 last year in Ukraine.

3.3.1 Passenger coach depot

TR has only one depot for maintenance of coaches, but it was said that a new depot was planned to be built in Hugand, designed for the maintenance of 1200(!) coaches per year and covering the major overhauls of the coach fleet from all the neighbouring countries.
It was not disclosed how this depot should be funded or how the plans progressed.

3.3.2 Dushanbe Coach Depot

The coach depot is taken into operation only three months ago.

The coaches undergoing maintenance are placed under a roof without any side wall. Lifting jacks and a gantry crane are available for lifting the coaches to remove the bogies.

The wheel shop has a wheel lathe from 1995 made in Ukraine, which was capable of re-profiling 12 wheel sets per day. but it only worked in one shift
It was claimed that the bogies are checked for cracks. but the were no facilities for washing the bogies. and no crack-detection equipment was shown.

Bearings were cleaned and re-greased. but there were no measuring equipment for the rollers.

In the machine shop seven tool machines (lathes. milling machines. radial drilling machines. and shapers) were installed. but it was said that for the time being there were no fitters available to operate the machine park.
The machines were fairly new (max 8 years)

Equipment for check of shock absorbers was installed but not in use. and lack of spareparts prevented repair of the shock absorbers

In addition the following shops were more or less in operation:

Shop for repair of valves for the brake system including valves and brake regulators

Battery charging and repair shop

Welding shop for repair of couplers
This is the only place where a component for the entire fleet was repaired.

Carpentry shop
There were no jobs for the railways due to lack of wood

Blacksmith with presses and chillns - not in operation

Next to the workshops washing facilities was installed for the cleaning of the coaches. but due to lack of gas . the water could not be heated

New Atlas Copco compressors for compresssed air

Large fairly new washing shop for bedlinen

3.4 Maintenance of wagons

The wagon depot in Dushanbe was the old depot for passenger coaches.

The lay-out for the maintenance of bogies. turning of wheels. and the usual cleaning of bearings was quite good and worked as a genuine production line

The two wheel lathes were fairly old. but one of them was in good working condition.

The remaining workshops were mainly a machine shop with a standard set of tool machines - lathes. drilling machines and shapers etc - all of them in working condition. but fairly old.

Workshop for repair of brake valves - in poor shape

4. Maintenance costs

In Tadjik roubles
Rate of exchange May 1996: USD 1 = 260 T.roubles

Total costs	**751190**
Salaries	161640
Insurance	59399
Un-employment (1% of salaries)	1625
Materials	39198
hereof for tracks	6606
Oil	224848
hereof fuel oil	204369
Electricity	25604
Depriciation	9962
Repair funds	117187
A Misc.	11172

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