Tacis

TRACECA :

Rolling Stock Maintenance - Railways

TNREG9309

Completion Report

Case studies, part 4/4

July, 1997

Part 4 : Case studies

Table of contents

Georgia's case study - Wagon rehabilitation

Table of contents

Executive Summary

Freight Wagons are tools to be used by the railway for earning revenue. The number of vehicles and cost of maintenance must be kept to a minimum if attractive rates are to be offered to freight customers and acceptable profit margins maintained by the railway.

The main recommendations of the report are that:

- The fleet of freight wagons should be reduced to a maximum of 5000, which will comfortably meet all projected traffic requirements.
- Surplus wagons should be sold off.
- The funds obtained by selling wagons should be used for improving the efficiency of the remaining wagons.
- A separate refubishment programme should be set up, as well as increasing the present rate of capital repair, to ensure that there are sufficent wagons available to meet both short and long term traffic requirements.
- The case for setting up a separate jointly owned wagon company to own,rehabilitate, lease back, and maintain, all freight wagons, should be evaluated.

The number of freight wagons owned by Georgian Railways is well in excess of the number of wagons required to operate current services, and to provide sufficient wagons for all forecasts of traffic growth in the future to the year 2015.

The fleet size is given as over 21,500 by GZD statistics, but according to a 1995 survey of wagons, only one third of this fleet is within Georgia. There are however over 8000 other wagons belonging to other administrations, mainly Russia and Ukraine, within Georgia.

Currently the daily wagon requirement for traffic is under 2400, and over 3500 wagons are available for use. The Consultant's estimate of traffic growth, together with necessary improvements in efficiency, shows a requirement for a fleet size of 2700 wagons. However even taking into account the much more optimistic forecast for traffic growth by the «TRACECA Infrastructure maintenance - Railways (Caucasus)» project, to year 2015, the maximum number of wagons required is well under 5000.

This study presents an approach to the rationalisation of the freight wagon fleet in Georgia by the realisation of the asset value of vehicles surplus to the real business need of the railway. Even taking the most optimistic projections for traffic growth, the wagon fleet could be reduced to 5,000, all of which should be operational, and this would allow the value of 16,500 wagons to be realised, at a minimum value estimated at US$ 6,000,000.

It is assumed that the total GZD fleet is available for consideration, and all calculations are done on this basis, but the following two potential scenarios must also be borne in mind, should a changed political situation develop:

- All wagons currently isolated within Georgia are made available to GZD.
- Only GZD wagons currently within Georgia are available.

The funds raised from the sale of the vehicles should be used to improve the operational fleet. Four options have been considered:

- Continue maintenance as a present.
- Replace with new wagons.
- Rehabilitate using existing technology.
- Rehabilitate using world market technology.

The study concludes that these funds can best be applied by introducing a higher standard of rehabilitation, revising existing maintenance procedures, improving working practices, and introducing computerised performance monitoring of wagon failures, including vehicle usage and repair costs. An essential development must be the setting up of a centralised department to purchase spare parts. No matter what option is developed, the availability of an adequate supply of spare parts is essential to prevent unreliability, and consequent additional work, caused by reuse of unsuitable second hand components.

There is not sufficient information at present to conclude whether or not there are any life cycle cost advantages in adopting components available on the world market, but it is recommended that pilot studies are undertaken to compare currently used components with the best obtainable on world markets. The current vehicles are of well proven design, but the level of attention and maintenance required is higher than normal. With improvements in standards of components and maintenance, the majority should not require replacement during the study period.

Three options to achieve these improvements have been outlined:

- Undertake the rehabilitation work within GZD.
- Set up a separate company to undertake the rehabilitation work under contract to GZD.
- Set up a wagon leasing company to own, rehabilitate, and maintain the wagons, with the responsibility to supply to GZD sufficient wagons to meet operational requirements under contract.

The report recommends that the financial case for setting up a separate wagon leasing company should further investigated, with an outside partner, to own, refurbish, and lease back the wagons, thereby giving GZD a greater control over costs, and enabling GZD to concentrate on the core business of obtaining profitable traffic and operating a railway.

1. Background

Since Georgia gained independence rail freight traffic has dropped from a pre-independence level of 36.2 million tonnes per annum (mtpa) in 1988 to 4.7 mtpa in 1995, or to 13% of its former volume. In terms of freight movement expressed on a tonne-km basis the fall has been even more marked, from 12.6 to 1.2 billion tonne-km, over the same period. The current situation is not likely to improve until after 2000, when freight volumes are anticipated to rise by 10% between 2000 and 2005.

The GZD wagon fleet currently consists of 21513 vehicles of which only 17% are available, and only 11% are required for traffic.

The present large number of freight wagons only acts to give a statistical image of a "big railway" and there is a need to reduce the fleet to a quantity commensurate with the actual business demands on the railway. At the same time, there is an on-going need to maintain the required fleet to a high standard so as to achieve internationally acceptable levels of availability and reliability. At present the maintenance of rolling stock in Georgia is considerably in arrears and many of the wagons in the fleet have been "robbed" of components to keep others in traffic. As traffic volumes are low relative to fleet size there is no driving force to improve availability; the greater than required number of vehicles actually acting as a dis-incentive to achieving quality vehicle performance.

In addition the report, prepared by GTZ GmbH, on the wagon survey in 1995, shows that in fact of the wagons allocated to GZD, only 7637 wagons were actually in Georgia, with the rest in other CIS countries,. However in Georgia there were 8410 wagons belonging to other CIS countries, mainly Russia and Ukraine. There may be problems in regularising this situation, but it is assumed for the purposes of this case study, that all Georgian wagons are available.

Without a coherent strategy to establish a reliable freight wagon fleet in Georgia there is a risk that rail will not be capable of handling its share of freight transportation in the future. There is, therefore, an urgent need to tackle the maintenance backlog problem and also to address the oversize fleet situation. It has been suggested that funds could be raised by selling the surplus vehicles to other CIS countries, or where this is not possible by prematurely realising the value of the materials by breaking up the vehicles for scrap, and that the moneys generated could be used to refurbish existing wagons or purchase new wagons.

The mixture of freight likely to be handled by the railway through to 2015 does not indicate the need for any vehicles of a type not already in the fleet. Similarly, the quantities of each type of wagon required up to 2015 can be met from those within the existing fleet. However, age spread of certain types will drive the need to purchase some new vehicles from 2005 onwards.

2. Future Freight Volumes in Georgia

The Consultant's projections of traffic growth are as follows:

YEAR	1995	2000	2005	2010	2015
Traffic Source	*Tonne 000s*	*Tonne 000s*	*Tonne 000s*	*Tonne 000s*	*Tonne 000s*
Domestic	1370	1370	1507	1790	2126
Exports	330	330	363	431	512
Imports	1225	1225	1347	1600	1900
Transit	1775	1775	1953	2320	2775
TOTAL	**4700**	**4700**	**5170**	**6141**	**7293**

These projections are based on zero growth to 2000, then 10% growth in the five years to 2005, and 3.5% growth annually thereafter to 2015.

The «TRACECA Infrastructure maintenance - Railways (Caucasus)» study gives a more optimistic rise in rail freight volumes in Georgia from 4.7 mtpa in 1995 to 17.5 mtpa in 2015 as illustrated by the following table:

YEAR	1995	2000	2010	2015
Traffic Source	*Tonne 000s*	*Tonne 000s*	*Tonne 000s*	*Tonne 000s*
Domestic	1370	2076	2748	3079
Exports	330	494	815	1019
Imports	1225	943	1179	1267
Transit	1775	8420	10525	12104
TOTAL	**4700**	**11933**	**15267**	**17469**

Wagon requirements are based on the number of wagons needed to transport domestic and export traffic, and these have been calculated using the Consultants' forecasts of traffic growth, which are not as optimistic as the «TRACECA Infrastructure maintenance - Railways (Caucasus)» project figures.

The domestic and export traffic forecast has been used by the «TRACECA Infrastructure maintenance - Railways (Caucasus)» project to develop the GZD freight wagon requirement through to 2015, and the Consultant has also taken these figures into consideration as a theoretical scenario to maximise the possible number of wagons required in the projections of this study on wagon refurbishment, even though it is considered that the actual number of wagons required will be much lower.

3. Wagon Fleet Requirements

The wagon fleet of GZD currently consists of 21,513 vehicles, according to information given by the GZD Department of Statistics, and an earlier analysis by type and age, furnished by the railway, gives the following age distribution:

	TYPE OF FREIGHT WAGON					
Year Built	**Covered**	**Open**	**Platform**	**Tank**	**Miscellaneous**	**TOTAL**
Before 1964	378	127	154	538	424	1621
1964 to1973	1588	1204	775	687	479	4733
After 1973	2522	4750	1481	1221	2856	12830
Totals	**4488**	**6081**	**2410**	**2446**	**3759**	**19184**

(World Food refrigerated vehicles and some miscellaneous vehicles not included).

According to GZD, only those vehicles built prior to 1964 are available for scrap, due to the current book life that is attributed to freight wagons. There is also a perception within GZD that there is a requirement for 12,000+ freight vehicles to meet traffic volumes, presumably all the vehicles built since 1973.

The most recent analysis of types of wagons, from GZD Dept.of Statistics, is as follows:

	TOTAL	**REQUIRE REPAIR**	**AVAILABLE FOR USE**	**NEEDED DAILY**
Covered KR	4805	4357	448	306
Low Side PV	5801	4965	836	607
Platforms PL	2435	2290	145	100
Oil Tanks TS	2950	1958	992	773
Hopper ZR	1246	638	608	150
Refrigerator XX	900	725	175	33
Contnr.Flats	259	145	114	74
Others	3117	2793	324	270
TOTAL	21513	17871	3642	2313

The Consultant's more pessimistic projections of wagon requirements are as follows:

Year	**1995**	**2000**	**2005**	**2010**	**2015**
	2783	2695	2597	2644	2616

Maximising the number of loading days, projected wagon requirements could be:

Year	1995	2000	2005	2010	2015
	2783	2695	1300	1542	1831

However, even the optimistic traffic projections developed in the «TRACECA Infrastructure maintenance - Railways (Caucasus)» study indicate that the requirement of freight wagons to meet 1997 volume flows is only 3538 and that this will only rise to 4642 vehicles by 2015 as illustrated by the following table:

Type of Wagon	Available Fleet	1997	2000	2010	2015	Max of Type
Covered	602	172	192	231	269	269
Open (Coal)	} 1090{	895	962	1077	1018	1077
Open (Iron Ore)	} {	737	716	737	702	737
Platform	319	711	837	1062	1230	1230
Oil Tank	1030	227	212	230	265	265
Refrigerator	105	381	424	511	597	597
Cement	125	19	26	33	31	33
Grain	912	255	249	255	294	294
Aggregate Hopper	453	141	164	246	236	246
TOTAL	**4636**	**3538**	**3782**	**4382**	**4642**	**4748**

It is of concern to note that since the 1996 «TRACECA Infrastructure maintenance - Railways (Caucasus)» Inception Report, the number of available wagons has decreased from 4636 to 3642, a reduction of 994, or 21%.

From the above figures will be noted that in the most optimistic scenario, the requirements to 2015 could not be met simply by maintaining the current operational fleet, and the considerable reduction in available vehicles in the last year gives cause for concern, even though there are sufficient wagons to meet current traffic requirements. Many of these stopped vehicles have had major components removed for use as spare parts to keep the available wagons operational and would require a major overhaul and the necessary new parts to render them fit for service again.

Whatever scenario is adopted the total wagon fleet required is expected to be in the range 2,700 to 4,700 vehicles, considerably smaller than the current fleet size and the perceived need of GZD. Therefore a reduction in the fleet size from 21,500 to 5,000 should provide a comfortable margin for unforeseen upturns in traffic. The Consultant considers that actual requirements will be much nearer the 2,700 figure.

Analysis shows that this lower quantity of wagons, with improvements in efficiency, is adequate to meet traffic demands to 2015, provided they can be maintained in a reliable condition.. Furthermore, with improved average speeds and wagon turn round times it is anticipated that even the most optimistic increase in domestic and export traffic volume to 4.098 mtpa by 2015 will be met by a growth of only 31% of the freight wagon fleet required in 1997, i.e. a total of 4462 vehicles by 2015.

4. Improving Wagon Performance

The need for the freight wagons to operate to Azerbaijan, Armenia and Russia is cited as the reason to stick rigidly to existing technology. Provided the means of coupling the wagons and their brake systems together remains standard (i.e. Couplers and Brake Hose connections), there is no reason why wagons with other components cannot operate within a train formation mixed with vehicles of the SZD standard. However there is a reluctance by the railway authorities to consider the adoption of new technology.

The question of dealing with failures distant from home depot could present problems. On the other hand the majority of freight traffic envisaged for GZD would be domestically based or export traffic through to Azerbaijan or Armenia. Distance from home base for wagons operating into the Caucasus is not perceived by the Consultants to be a problem, and in fact it may be possible to develop the same wagon technical solution on a regional basis for the Caucasian countries.

For example, wheel and axle assemblies manufactured to the latest standards, as used by western European railways, could be installed, together with quality axle bearings, without affecting the ability of the wagons to operate into other countries. However, if new brake equipment is to be installed the system must work to the same pressures and ratios as the rest of the fleet, but to achieve this is no great problem for competent brake equipment manufacturers.

Justification for moving away from the existing technology toward proven world market technology must be based on life cycle cost. Comparisons must not be made on first cost alone. The ultimate life of the component, interval between overhaul, cost of overhaul, and reliability in service all contribute to the life cycle cost of the component. Similarly the summation effect of all components contributes to the overall reliability and running cost of the vehicle.

5. Towards Best International Practice

Wagons are relatively simple, having only three major technical areas (I) the coupling interface, (ii) the braking system, and (iii) the running gear. Refurbishment and rebuilding to specifications commensurate with best international practice does not, therefore, present a major technical problem if the wagon frames and bodies are in reasonable condition. Whereas the coupling interface must be kept standard to ensure inter-working of vehicles in trains, the use of world market components for brake equipment, and wheels, axle, and journal bearings, should not present difficulties.

There is a question of reliability of the existing wagons. Although the wagon structures are sturdily built, the brake equipment and running gear is of standard SZD design, and requires considerably more maintenance than would be acceptable in a market led organisation. Such questions as quality and durability of materials, as well as quality of maintenance workmanship arise, when compared with the life achievable with equivalent equipment which as been developed in a cost driven technological environment.

In particular, it has been noted that wheel life is comparatively short - between one and three years. Although this is in part due to the condition of the infrastructure and the tight curves in the mountainous section between Zestafoni and Khashuri, there is also the question of the grade of steel being used for the wheels.

Furthermore, the overhaul period for the roller bearings used on the axle journals is about three years compared with a period of seven to eight years which is the normal interval for freight wagon axle bearings produced by manufacturers such as Timken, SKF or FAG.

A major problem with overhaul of the current axle bearings and brake equipment is that the component parts are also only available from the traditional suppliers in Russia or the Ukraine. As such GZD is not in a position to "shop around" in the world wagon component supply market to obtain alternatives. The prices charged by Russian manufacturers are moving towards world market levels. On the other hand manufacturers in the west are competing on quality as well as price, and the use of standard components allows inter-changeability between suppliers.

It has been very difficult to obtain an overall view whether problems with reliability and failures are due to the quality of the materials, or to working practices, due to lack of recorded information and analysis. It is recommended that GZD set up a computerised performance monitoring system, recording details of all problems in service, failures, defects, running repairs, and scheduled maintenance, against each wagon. Ideally this system should have an input terminal at each wagon depot, but initially information could be sent to a central point, for input and analysis.

It is also recommended that pilot tests are set up to compare the current equipment against equipment available on the world market, to evaluate whether or not there is a life cycle cost benefit for GZD in any change of supplier. Areas where there may be a potential benefit are:

Wheelsets, complete.
Wheels.
Axle bearings.
Brake distributors and other components.

The tests will provide an opportunity to evaluate why there is so much more maintenance and attention necessary to the current equipment than would be expected, based on other standards.

Manufacturers should be keen to co-operate in such tests, as if they can demonstrate a life cycle cost benefit, with a consequent financial saving to GZD, by the adoption of their equipment, it could open up a potentially vast market

On the other hand, if the quality and prices of the Russian or Ukrainian equipment matches up to world standards, it will demonstrate that maintenance procedures and standards may require considerable improvement.

A typical breakdown of all work, including overhaul, on an annualised basis for open wagons in use on mineral ore or coal traffic in Europe is as follows:

Activity	Hours	Material
Trip Examinations	18.96	
Running Maintenance	22.85	
Preventive Maintenance Examinations	26.59	
Brake Gear including Brake Blocks		US $649.8
Bogies and Under-frame	3.30	
Wheel turning	1.07	
Ultrasonic Axle Testing	0.74	
General Repairs (including wheelsets)	36.11	US $276.2
Total	**109.62**	**US $926.0**

The above figure includes all work on a wagon and can be re-defined as follows:

Examination and Running Maintenance	68.40
Wheel Turning and Testing	1.81
Overhaul	39.41

GZD employs the following staff on wagon maintenance to cover the above work:

Stalin Plant (say 50% on wagons)	1,000
Khashuri Wagon Depot	400
Samtredia Wagon Depot	454
Batumi Wagon Depot	380
Total number of staff employed	2234

It is presumed that all staff in the 15 Technical Examination Units are included in the above numbers. The figures also include technical and administrative staff.

Projecting time costed against each wagon in European terms against a GZD operational fleet of say, 5000 wagons, gives the following:

Hours per wagon 109.62 x number of wagons 5000	=	548,100
Man hours per man per year 40h x 48 weeks	=	1,920
Total number of staff required	=	285.

There is no doubt that GZD should set its target as best international practice for wagon fleet performance. Availability figures of 90% plus are the norm to be aimed for and reliability of 150,000 km between failures. Whereas the initial cost to achieve such goals can be higher than that experienced in the past for wagon components, the resultant lower maintenance costs and higher availability mean that the overall cost of maintaining the required operational wagon fleet is reduced by two factors (a) smaller fleet size, and (b) lower maintenance cost per vehicle.

One of the first objectives must be to set the standards required for new and refurbished vehicles. Although it is not anticipated that any new vehicles will be required before 2005, based on current traffic flow predictions,

new business requiring specialised vehicle types may drive the need to purchase. It is essential for a small fleet of around 5,000 vehicles to ensure standardisation. To a great extent this had been achieved by SZD standards, but as previously discussed the quality and reliability are open to question. The technology selected for refurbishment must also be the technology for new wagon builds, i.e. brake equipment, wheel bearings, etc. must be of a common design. However, any refurbishment of the fleet, particularly if world market components are adopted, will need to be backed up by training and support for the required maintenance regime.

One other feature of current GZD thinking is that everything to do with maintenance must remain embedded in the standard instructions that have applied since the old regime. Maintenance, like every other activity of a commercial railway, must be business driven. There is no sense in slavishly following maintenance procedures that are not reviewed against operating trends and changes in duty cycle of the vehicles. This means that GZD personnel must take responsibility for constructive changes to reduce the cost of maintenance.

Maintenance procedures and techniques must ensure that the maximum life is obtained from components, without allowing wear to get to a point where re-working becomes costly. Basically the philosophy must be to maintain "just in time" at a point before excessive wear or failure occurs. This requires an pro-active maintenance monitoring system, and all vehicles refurbished to the new standard must be maintained, and have all maintenance activities properly recorded and analysed.

6. An Approach to Fleet Rationalisation

It is considered that a four-part approach is required to rationalise and rehabilitate the wagon fleet. The various elements may be summarised as follows:

Part 1 To meet the requirements of a fully operational fleet of 5000 wagons, there is a requirement to refurbish approximately 2863 stopped vehicles in the seven years 1998 to 2004 inclusive. This assumes that the fleet will consist of 2863 working vehicles and 2142 stopped vehicles by the end of 1997 based on the same drop-out rate of 21.4% as at present. A further 721 vehicles will drop out before 1999 when the rate of refurbishment will exceed the drop out rate. The refurbishment programme will use only new material.

Part 2 The balance of the requirements for 1997 to 2005 can be adequately met from the existing available fleet. The 2783 vehicles now needed must be selected from the available fleet and a robust programme set up to overcome the maintenance backlog and keep these wagons in running order. A compressed programme of KRs is recommended, spread over the seven years 1998 to 2004, at the rate of 306 vehicles per year. This will result in 2142 of the old vehicles being up to date as regards maintenance by the end of 2004 as illustrated in the following table:

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	Total
Refurbishments	0	409	409	409	409	409	409	409	2863
KRs	0	306	306	306	306	306	306	306	2142
Upgraded Fleet	0	715	1430	2145	2860	3575	4290	5005	5005
Old Working Fleet	2863	1943	1221	653	207	0	0	0	0
Total Working Fleet	2863	2658	2651	2798	3067	3575	4290	5005	5005
Stopped Fleet	2142	2347	2354	2207	1938	1430	715	0	0
Total Fleet	5005	5005	5005	5005	5005	5005	5005	5005	5005
Dropouts	614	417	262	140	440	0	0	0	

The total working fleet does not start to increase until after 2000, so at that stage there is an opportunity to review the demand for wagons against the actual and projected traffic levels pertaining at that time. This may result in a reduced refurbishment and overhaul programme in subsequent years if traffic volumes are more in line with the Consultant's pessimistic projections than the «TRACECA Infrastructure maintenance - Railways (Caucasus)» project optimistic projections.

Part 3 The KRs on the 2863 refurbished vehicles will have to start in 2005, three years ahead of the first due date, in order to smooth out the demand created by the introduction of a large quantity of refurbished vehicles in 1998-2004. With a continuation of overhauls at the rate shown below the fleet will be kept in date by adopting this approach. The resultant overhaul programme for 2005 - 2014 will be:

YEAR	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Refurbished	286	286	286	286	286	286	286	286	286	286
Old Wagons	169	168	131	110	107	107	108	107	108	107
Annual	455	454	417	396	393	393	394	393	394	393

Part 4 It will be necessary to commence the introduction of new vehicles into the fleet from 2005 in order to ensure that the age profile of the fleet does not become too imbalanced towards older vehicles. The table below illustrates a proposed new wagon building programme for 2005 to 2014:

NEW WAGON CONSTRUCTION

YEAR	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
COVERED						7	8	7	8	7	37
OPEN	14	14	31	40	41	54	54	54	54	54	410
FLAT	23	23	35	41	43	73	73	73	73	73	530
TANK						8	7	8	7	8	38
REFER	8	9	17	23	23	44	44	44	44	44	300
GRAIN						8	8	8	8	8	40
AGGREG.						8	8	8	8	8	40
TOTAL	45	46	83	104	107	202	202	202	202	202	1395

The changes in the age mix of the fleet as a result of the foregoing programmes would be as follows:

TYPE	OLD		REFURBISHED		NEW		TOTAL	
Year	Quantity	% of Total	Quantity	% of Total	Quantity	% of Total	Quantity	% of Total
1998	2249	85%	409	15%			2658	100%
2000	1571	56%	1227	44%			2798	100%
2005	2142	43%	2863	57%			5005	100%
2010	1717	34%	2863	57%	425	9%	5005	100%
2015	747	15%	2863	57%	1395	28%	5005	100%

From the foregoing it will be observed that the four-part approach to rationalising and refurbishing the wagon fleet results in a good mixture of old, refurbished and new vehicles by the end of 2014. However, to achieve this objective requires an aggressive start to the refurbishment programme in 1998 and the implementation of an on-going heavy overhaul programme.

7. Options for Freight Fleet Improvement

In reviewing the current status of the wagon fleet, and the potential growth in freight traffic as indicated in the «TRACECA Infrastructure maintenance - Railways (Caucasus)» study, the Consultants consider that there are three options possible to achieve a reliable cost effective freight wagon fleet in Georgia. All three options are based on the premise that every wagon surplus to the business requirement of the railway will be disposed of, and the funds so raised used to rehabilitate/re-furbish the required fleet.

Every effort should be made to sell off the surplus wagons to other CIS countries who are forecast to have a need for certain types of wagons. Only when these avenues are exhausted should the selling of wagons for the basic scrap price be considered.

As far as value of the scrap steel is concerned, European processors in Spain or Greece were buying at between US $120 and US $135 per tonne CIF at Port of delivery in 1996. However, in terms of what might be obtained by the seller, certain handling costs must be deducted. For example, scrap steel previously obtained from GZD resulted in a payment of US $20-30 per tonne following deductions. Current costs are estimated as given below:

COST ITEM	US $/tonne
Scrap processing	25
Rail transport to Port	15
Charges due to delays	05
Port Costs	12
Miscellaneous	03
Payment to seller	25-30
Export Price	85-90
Export Tax	15-20
Shipping & Insurance	20
CIF Price	120-130

Currently it is illegal to export scrap from Georgia, but it is expected that by the end of May 1997 the Government will have passed laws to permit export and to levy an export tax. The tax is expected to be around US$15 -20 per tonne.

The options which are available are:

1. GZD to undertake the project within its existing corporate structure, thereby keeping control of any funds raised by the sale of surplus wagons, and the subsequent use of such funds, within the control of the railway.

2. Set up a separate company purely for the refurbishment of wagons, and to make an asset transfer of the surplus wagons into this organisation as part of its working capital. Refurbishment of wagons would be done under contract to GZD.

3. Transfer the entire wagon fleet into a Rail Freight Fleet Company and lease the required fleet back to GZD. Not only would the company be responsible for the sale and the refurbishment of wagons, but

also for the supply of wagons to the railway to agreed standards of availability and reliability. This company would also be responsible for the ongoing wagon maintenance and overhaul, and the procurement or construction of new wagons.

Option 1 presents little opportunity for the development of a commercial business and is a purely once off exercise to rehabilitate as many wagons as possible with the funds raised from the sale of scrap. There is unlikely to be any interest from corporate partners in forming a joint venture with GZD or little opportunity for funding of such a limited project which may only serve to perpetuate the status quo.

Option 2 has more commercial possibilities and would be perceived as a fixed duration project by potential investors. By virtue of being limited in duration and workload, commitment to a Joint Venture partnership by wagon industry specialists in the west is not likely to be great, and would not be of long term benefit to Georgia.

Option 3 presents a scenario of a long term business in which investors have an opportunity to make returns on the long term cash flow from lease fees and maintenance charges. In such a situation there is more likely to be interest in corporate partnership, particularly from companies involved in the wagon component manufacture and repair business. The possibility of bringing wagon assembly or construction into the scope of the project as it develops may well prove an attraction to wagon industry companies.

In view of the need to secure investment and expertise to bring the wagon fleet up to a standard equivalent to best international practice, it is recommended that Option 3 be developed. The following section outlines a strategy that may be adopted to develop a Rail Freight Fleet Company in Georgia which could provide reliable freight wagons (including maintenance, overhaul and renewal) to GZD under a lease agreement.

8. Strategy for a "Rail Freight Fleet Company"

The proposal for a Rail Freight Fleet Company (RFFC) envisages that all freight wagons currently in the possession of GZD would be transferred into the company and that GZD's requirements for its operational needs would be met by leasing back from the RFFC. Maintenance and overhaul of the wagons would be carried out by the RFFC who would guarantee levels of availability and reliability in the lease agreements with GZD. The business would be a totally separate entity to the railway and run as a strictly commercial concern generating a return on its assets.

Methods whereby the company achieves its objectives in providing wagons to GZD will be decided within the RFFC, and they would have the ability to realise the maximum value for any wagons disposed of. All cash realised for the sale of wagons should be held by the company for the refurbishment project together with any grants, loans or other equity that might be obtained from Joint Venture partners.

In order to vest the wagon fleet into the RFFC as an asset base the transfer arrangement with the railway will need to be overseen by the Transport Ministry, Valuation of the assets would have to be undertaken and the agreed amount could be considered as book transfer.

Refurbishment of the required number of stopped vehicles will probably require between US $16,000 ands US $20,000 per vehicle depending on the condition. As most critical parts have been "robbed", and wheels probably have little life left in them. Bearings could also be damage due to the vehicles lying idle for long periods. Typical costs for modern components would be as follows:

Wheel & Axles Assembly (including bearings) $4,000 each;	$16,000 per vehicle
Air Brake equipment (valves, reservoirs, etc.)	$3,250 per vehicle
Refurbished automatic couplers	$750 per vehicle

Competitive purchasing in bulk could reduce these prices by up to 25%

It is recommended that the railway contributes a percentage of the refurbishment cost as it will be gaining the benefits from the overhauled vehicles. This figure should perhaps be the equivalent of what is currently paid for major capital repair - any enhancement over and above a KR should be met from the scrap fund. Refurbished vehicles should be re-valued for depreciation purposes.

To progress on this proposal it will be necessary to carry out a full financial appraisal, involving potential partners in the venture, and showing the benefits to GZD, before a firm decision can be taken.

9. Evaluation

In order to assess in economic terms the relative costs of rehabilitation compared to other options for developing the wagon fleet, the following alternatives have been compared in terms of capital costs of new wagons, capital costs of rehabilitated wagons with either existing or modern technology components, and annual maintenance costs:

- Continue as present - operating the existing wagons in their present form until eventual replacement by modern wagon types, through purchasing new spare parts (or cannibalising more wagons in the short term) until they reach the end of their working life,
- Scrap all existing wagons in the short term (by about 1998) and buy wagons of modern designs,
- Rehabilitate wagons, in accordance with the programme described in this study, to meet demand in the long term (2008) using existing technology used in Georgia (except that for simplicity no new wagons are assumed to be acquired before 2008),
- Rehabilitate wagons, in accordance with the same programme, to meet demand in the long term (2008) using modern rather than existing technology for key components.

Each option involves scrapping surplus wagons and this reduces the capital requirement of each alternative, especially for alternative (b).

The evaluation assumes:

- the costs estimated in the main study report for the TRACECA Region, modified where necessary to reflect Georgian conditions,
- the optimistic traffic forecast described earlier,
- maintenance productivity and equipment utilisation improvements, particularly under alternatives (b) and (d) using modern technology,
- all wagons expected to be surplus to requirement by 2008 are scrapped in 1998.

Details of the assumptions are given in Annex C and summarised in the table below.

	Existing Wagons		**Wagons Rehabilitated with Existing Technology**		**Wagons Rehabilitated with Modern Technology**		**New Wagons**	
	1998	2008	1998	2008	1998	2008	1998	2008
Availability (%)	80	80	80	80	85	85	90	90
Annual Km per Wagon	70,000	70,000	70,000	70,000	74,400	74,400	79,000	79,000
Life (years)	30	30	30	30	30	30	30	30
Economic Maintenance Costs								
- materials (US Cents per km)	2.1	4.2	2.1	2.1	2.0	1.8	2.0	1.3
(US $ per year)	1,470	2,940	1,470	1,470	1,488	1,339	1,580	1,027
- staff (US $ per wagon per year)	280	420	280	420	280	380	280	340
- other (US $ per wagon per year)	170	250	170	250	170	230	170	200
TOTAL Maintenance Cost (US $ per year)	1,920	3,610	1,920	2,140	1,938	1,949	2,030	1,567

Based on these assumptions, the fleet development under each alternative is summarised in the following table.

	Alternative (a)		Alternative (b)		Alternative (c)		Alternative (d)	
	1998	2008	1998	2008	1998	2008	1998	2008
Wagons Needed								
- New	0		3,216	3,780	0	0	0	0
- Rehabilitated	0		0	0	1,210	1,789	1,210	1,789
- Other	3,618	4,253	0	0	2,408	2,464	2,332	2,352
TOTAL	3,618	4,253	3,216	3,780	3,618	4,253	3,542	4,141
Wagons Scrapped	16,402		20,655		16,402		16,514	
Cost of Wagons (US $ million)								
- New	0.00	0.00	192.96	226.83	0.00	0.00	0.00	0.00
- Rehabilitated	0.00	0.00	0.00	0.00	16.94	25.05	21.78	32.20
TOTAL	0.00	0.00	192.96	226.83	16.94	25.05	21.78	32.20
Value of Scrap (US $ million)	10.25		12.91		10.25		10.32	
Maintenance Cost (US $ million per year)								
- New	0.00	0.00	6.53	5.92	0.00	0.00	0.00	0.00
- Rehabilitated	0.00	0.00	0.00	0.00	2.32	3.83	2.34	3.49
- Other	6.95	15.35	0.00	0.00	4.62	8.90	4.48	8.49
TOTAL	6.95	15.35	6.53	5.92	6.95	12.72	6.82	11.98

Under alternative (a), which is continuing at present without any major investment in rehabilitation or wagon acquisition, about US $ 10.2 million can be raised from scrapping wagons and there is no capital investment in new wagons or rehabilitation. However annual maintenance costs for the wagon fleet are high - about US $ 15.3 million.

By comparison, acquiring a completely new wagon fleet under alternative (b) incurs a very high expenditure of US $ 226.8 million by 2008 (even after allowing for US $ 12.9 million raised from scrapping wagons). Annual maintenance costs are only US $ 5.9 million in 2008 which is US $ 9.4 million lower than alternative (a), implying a ratio of annual benefits to costs of only 4.2% in 2008.

Alternative (c), which involves rehabilitation with existing technology components, incurs US $ 25.1 million capital expenditure (and raises US $ 10.2 million from scrapped wagons) and is expected to result in annual wagon maintenance costs of US $ 12.7 million in 2008 (US $ 2.6 million lower than alternative (a)). The ratio of annual benefits to costs is 10.4% in 2008.

With alternative (d), under which wagons are rehabilitated with modern technology, capital expenditure is expected to be US $ 32.2 million (and US $ 10.3 million is raised from scrapped wagons). Although this cost is greater than alternative (c), the annual benefits are also greater (annual maintenance costs are US $ 12.8 million in 2008 which is US $ 3.4 million lower than alternative (a)). The ratio of annual benefits to costs is similar to alternative (c), at 10.6% in 2008.

With the many assumptions that have to be made in such an evaluation, only tentative conclusions can be reached. Nevertheless these results suggest that compared to continuing as at present with a wagon fleet in poor condition, or replacing the existing fleet with a modern fleet, the proposed rehabilitation programme offers significant cost advantages.

The difference, if any, between overall costs of wagons rehabilitated with existing or modern technology components seems to be small, and so the question over whether or not existing or new technology components should be introduced cannot be resolved with available information. More investigations would need to be carried out over a period of time to determine relative maintenance costs of wagons with and without modern components, under similar operating conditions.

10. Opportunities for Joint Venture Partners

As part of the study the Consultants wrote to 24 European wagon construction and wagon component manufacturing companies to ascertain the level of interest of involvement with refurbishment of wagons in Georgia; a list of the companies contacted being included in Annex A. The response was varied and the response from those companies which expressed a positive interest is included in Annex B.

In addition a German company based in Georgia has expressed an interest in participating in wagon refurbishment. Information is also given in Annex B.

11. Conclusions and Recommendations

1). The present GZD fleet of 21,500 wagons is much greater than the maximum number of wagons required in the future.

2). The fleet should be reduced to a maximum of around 5,000 wagons, and all these wagons should be made operational to meet future requirements.

3). Surplus wagons should be disposed of to raise funds, estimated at US$6,000,000.

4). The existing operational fleet is reducing rapidly, and to continue at the present rate of drop out will mean that within the next few years there will be insufficient wagons to meet traffic demands.

5). The best way forward is to set up a separate refurbishment programme to rehabilitate the stopped wagons at a rate of 409 per year for the next seven years.

6). In addition the programme of KRs (10 year wagon capital repair) must increased to 306 per year, with improved standards, to keep the running fleet operational.

7). Funds must be provided to meet the requirement for spares and materials, and a centralised procurement department set up to place orders, and control material stock.

8). A computerised performance monitoring system to record all details relating to wagon performance and maintenance should be put in place.

9). Evaluation trials of world market components should be instituted with manufacturers, together with comparative evaluation of existing components.

10). Maintenance procedures should be reviewed, and brought in line with the requirements of a market economy, not a "full employment" economy.

11). Deviation from "the Plan" will be necessary to achieve comparative levels of work content and costs.

12). The overhaul of components should be centralised at one location, with improved facilities, and the depots should carry out depot repairs on the basis of unit exchange.

13). The financial case for the setting up of a separate jointly owned Rail Freight Fleet Company to own, refurbish, maintain, and lease back, wagons, should be investigated.

14). A policy should be determined in regard to "lost" Georgian wagons and foreign wagons marooned in Georgia.

End of Wagon rehabilitation

Annex A Wagon Refurbishment - Companies contacted.

The following companies were invited to indicate their interest in a wagon refurbishment programme in Georgia.

WAGON BUILDERS

ABB Henchel AG, Mannheim, Germany.
ABB Scandia A/S, Randers, Denmark.
Arbel Fauvet, Suresnes, France.
Bombardier Prorail, Wakefield, U.K.
CAF s.a., Madrid Spain.
Keller SpA.,Palermo, Italy.
Linke-Hoffmann-Busch, Salzgitter, Germany.
O.& K.,AG.,Dortmund, Germany.Powell
Duffryn Standard Ltd., Cardiff, U.K.
Rautaruukki, Oulu, Finland.
Remafer, Reims, France.

COMPONENT MANUFACTURERS

ADtranz, Manchester, U.K. (Wheelsets)
Blair Cotton Rail Products, U.K. (Couplers)
Davies & Metcalfe plc, Stockport, U.K. (Brakes)
FAG, Eelangen, Germany. (Bearings)
Ferrostaal AG., Essen, Germany.(Wheelsets)
Knorr Bremse GmbH., Muenchen, Germany.(Brakes)
Krupp Lohnro GmbH., Essen, Germany. (Wheelsets)
Sab-Wabco AB., Lanskrona, Sweden. (Brakes)
SKF, Milton Keynes, U.K. (Bearings)
Timken Europa GmbH., Hanover, Germany. (Bearings)
Westinghouse Brakes Ltd., Chippenham, U.K. (Brakes)
Valdunes, France. (Wheelsets)
ZDB A.S.,Bohumin, Czech Republic. (Wheelsets)

Annex B Responses from Manufacturers

POSITIVE INTEREST
Thr following companies expressed an interest in potential future participation:

Powell Duffryn Standard Ltd., Cardiff, U.K.
Interested in supplying modern technology low track force bogies.
Linke-Hoffmann-Busch, Salzgitter, Germany.
Not in a position to participate at present, but could be interested in 1998.
Ferrostaal AG, Essen, Germany.
Are interested in the project.
CAF s.a., Madrid, Spain.
Interested in supplying wheels and axles.
Rautaruukki, Oulu, Finland.
Have an interest in investigating joint participation in the refurbishment of wagons, and in future supply. Have supplied wagons to Russia.
Davies & Metcalfe plc, Stockport, U.K.
Interested in supplying brake equipment and couplers.
Blair Cotton Rail Products, U.K.
Interested in supplying couplers and bogie castings.
Westinghouse Brakes Ltd., Chippenham, U.K.
Interested in supplying brake equipment.

In addition, a German company, DOK-Tbilisi, a joint Georgian/German venture, has shown an interest in the wagon project. The company has cut wagons in the past and sold them for scrap, taking a lease on part of the port of Poti., and are working on other joint ventures.
The company is prepared to look at setting up a wagon repair business.

Azerbaijan's case study : tank wagon workshop

Table of contents

1. Introduction

Following the economic disruption caused by the break-up of the former Soviet Union (military conflicts, constraints on trade and economic restructuring), rail freight traffic on Azerbaijan Railways (in tonne km) has fallen to only 5% of its peak 1988 level. Traffic has fallen by similar amounts in neighbouring countries. Production of refined oil in Azerbaijan has fallen drastically.

The tank wagon workshop in Baku had established itself as a high quality workshop able to carry out capital repairs of tank wagons. Even now it carries out some capital repairs for neighbouring countries, including Russia. However the condition of the workshop is deteriorating: it is over 100 years old and not designed for its present function. Provision of a redesigned and improved workshop would enable improvements to be made in the quality of capital repair work which could reduce overall maintenance costs of wagons.

Azerbaijan Railways are currently considering a proposal to build a new tank wagon workshop described in "Business-Plan for Construction of Baku Tank Wagon Repair Works", Giprozavodtrans, 1996. This report included a financial evaluation based on former Soviet Union evaluation practices which indicated that a new workshop could be regarded as self-financing if the workshop received appropriate remuneration from the railway for the services it rendered, especially if a reduced scale or "minimum model" project (proposed by the current TRACECA study) was implemented.

During the analysis of rolling stock maintenance at the Azerbaijan railway, it was decided to perform a case study of the tank wagon repair shop at Baku with a view to produce material which would allow immediate consideration of funding of rebuilding or refurbishment.

This case study was selected as one of a total of four to be carried out as part of the rolling stock study.

2. Background

During the field work in Baku in July 1996, several options for improving the possibilities of capital repair of wagons were discussed.

The facility presently available for this purpose is an old locomotive repair shop, located in the city of Baku. The railway expressed a wish to tear down the existing facility and to built a complete new facility. In order to be able to present an alternative solution, the consultant suggested an investigation of the option of rehabilitating the existing facility.

The railway had already commissioned the Ukranian firm, Giprozavodtrans Institute, to carry out a preliminary design of a new tank wagon repair plant. This design can form the basis for further work on renovation of the plant, should this solution be chosen.

The consultant urged the railway to establish an inter-railway group to work with the alternative of a rehabilitation of the existing facility. This group was formed during the visit of the consultant to Baku in November 1996, and a first meeting was held. When the consultant returned in February 1997 to discuss the findings of the group, it appeared that a result had not been reached, and that no user's requirements for a renovation had been prepared.

The consultant chose to prepare their own version of a rehabilitation, based on the findings of the field visits. They furthermore, in cooperation with the railway and Giprozavodtrans, defined the first phase of constructing a completely new facility in order to allow the step by step development of a new workshop. This would secure a wider range of technical options for inclusion in the evaluation.

3. Demand for Capital Repairs

3.1 Traffic Forecasts

Two scenarios for future traffic development have been considered when evaluating the proposed improvement of the workshop. These cover the likely range of alternative traffic levels that could be expected.

Past railway traffic forecasts in the region look rather optimistic. For example even in the pessimistic scenario of the TRACECA Infrastructure Maintenance project, traffic growth of 100% between 1995 and 2000 is expected. This is rather unlikely, taking into consideration that in 1996 no real changes were reported.

Those forecasts are based on high growth of oil products, which would require upgrading of refinery plants. However there are no firm financing plans for this. Several oil companies are planning to move crude oil out of the Azerbaijan and Kazakkstan oil fields to the Black Sea, especially to the port of Novorossisk in Russia. In all cases pipeline is the mode of first choice. Nevertheless there is considerable potential crude oil traffic which could be carried by rail from east to west, through Azerbaijan and Georgia, as a temporary measure until alternative pipelines are constructed. It is understood that Chevron has such plans in the short term. Unfortunately the Ajerbaijan International Operating Company (AIOC), which has members from a number of major oil companies and is investing heavily in the region, has informed us that they have no plans to use the railway. Instead they will develop the pipeline alternative. It is therefore concluded that any possible crude oil rail traffic would be strictly a short term affair, and not a suitable basis for evaluating long term investments in workshops.

In view of the limited prospects for sustained growth in rail traffic, high traffic growth is very unlikely.

The Regional Traffic Forecasting Model gives the following results for the year 1995 :

- 764 000t were import by rail, 931 000t were exported by rail,
- 786 000t of mineral products (assuming that there are oil products in Azerbaijan) were exported by rail, 1 500 000t exported by sea.

This means that 30% of oil products are exported by rail, and oil traffic represents a maximum of 8,000,000 t of the goods transported by rail

3.1.1 Pessimistic assumptions

The pessimistic traffic forecast is based on the projections made in the main study.

As in the case of other TRACECA countries, traffic is assumed to remain constant until 2000, and then increase by 10% between 2000 and 2005. Continued growth is assumed at a similar rate up to 2010. Such growth would be feasible if the refinery in Azerbaijan is rehabilitated for supplying the domestic market and if the railway is used to a significant degree for local distribution (over distances of about 250 km).

With such short hauls the turn around time of wagons should not be higher than 5 days.

In 1995 the turn over was 2.25 billion ton.km and the quantity of freight transported was 8.98 million tons. Based on the estimates in the main study, the total required fleet of wagons in Azerbaijan is 2,600 in 2000 and 2,860 in 2005 according to the recommended development alternative (with management improvements which improve utilisation and efficiency). By 2005 the required number of wagons could reach 3,146.

Overhauls are carried out every 8 years for tank wagons (which constitute the majority of wagons) and 12 years for other types. Assuming 8 years, the total number of overhauls to be carried out every year is 320 in 2000, 360 in 2005 and 390 in 2010.

3.1.2 Optimistic assumptions

The optimistic traffic scenario is similar to the optimistic forecast made by another TRACECA study, ("Infrastructure 1 - Railways" carried out by the TEWET consultants). It implies re-establishing the north-south corridor linking Russia, Iran and Turkey, despite recent political conflicts. It assumes that production of refined oil gradually recovers to historic levels and that rail transport is used for carrying most Azerbaijan refined oil consumed domestically and exported. Oil transport therefore becomes about 90% of all rail traffic in Azerbaijan. Such forecasts are valid only if the oil refinery recovers output (which is far from certain) and if the railway manages to secure most of this traffic. In fact much of the current traffic is carried over short distances and the railway does not get paid for most of its oil traffic, so there is the possibility that much traffic diversion to road could eventually take place if the customers are forced to pay for rail transport.

Under this scenario, oil traffic doubles by 2000 and doubles again by 2005, which means that 17 million tonnes are to be transported in 2000 and 33 million tonnes in 2005. Traffic growth of 10% is assumed between 2005 and 2010. Taking into consideration that 90% of the freight is transported over even shorter distances than assumed for the pessimistic scenario, the turn around of wagons should decrease to a maximum of 3.5 days over a distance of about 200 km.

According to those very optimistic assumptions, the total fleet requirement is 2750 wagons in 2000, 5300 in 2005 and 5,830 in 2010.

Accordingly, the total number of overhauls would be 340 in 2000, 660 in 2005 and 730 in 2010.

3.2 Capacity of the workshop

3.2.1 Railway's Assumptions

The railway has reported the following production figures for the Baku tank wagon workshop:

	1994	1995	1996
Capital repair 4 axle tank wagons	223	350	434
Capital repair 8 axle tank wagons	-	11	-
Capital repair 4 axle special TW	205	4	22
TOTAL CAPITAL REPAIR	428	365	479

In addition

Depot repair	-	18	-
Running repairs	-	249	-

Furthermore, the railway has the following planned work in the shop for 1997:

Capital repairs:

Azerbaijan	600
Russia	150
Kazakstan	40
Private wagons	90
TOTAL	880

Depot repair

Azerbaijan 150

Additionally, 3,600 wheelsets are to be produced.

The above figures may not be achieved in practice. Almost no foreign railway has been sending wagons to Baku in recent years, so the number of foreign wagons is particularly uncertain.

The railway plans the following production in the workshop for the following years:

	1998	1999	2000
Azerbaijan	600	600	600
Contracts	364	473	615
TOTAL	964	1073	1215

Again the figures are subject to considerable doubt because of uncertainties about traffic and the use of the Baku workshop by foreign railways.

3.2.2 Consultants Assumptions

According to our assumptions, tank wagons from Georgia would be maintained in Baku. The main study estimates that there is a requirement for 720 tank wagons in Georgia in the short term (2000), rising to 790 in 2005. It is projected that the requirement becomes 940 in 2010. This would represent an additional 90-120 overhauls per year.

It is assumed that the production of the workshop is one wagon in 5 days, which is higher than the time imposed by the procedures, but it is a realistic time applied in many other places. This production can be achieved with one shift 5 days a week, and could be increased considerably by week end shifts, and working two rather than one shift per day.

The number of bays (room required for the maintenance of one wagon) is given in the following table for the target years 2000, 2005 and 2010. Note that overhauling foreign wagons could increase the work load considerably. Based on the railway's plans, 280 non Azerbaijan wagon overhauls could be carried out in 1997, rising to 615 in 2000. This represents about 30-70% of the Azerbaijan wagon work. Allowing for the assumed overhauls of Georgian wagons, this would imply rather less than 50% additional overhauls than estimated in the table. Such additional work could comfortably be carried out without increasing the number of bays, if multiple shifts are worked.

	2000		2005		2010	
	Pessimistic	Optimistic	Pessimistic	Optimistic	Pessimistic	Optimistic
Wagon Fleet Required						
- Azerbaijan	2,6	2,7	2,8	5,3	3,1	5,8
- Georgia	720	720	790	790	940	940
Wagon Overhauls						
- Azerbaijan	320	340	360	660	390	730
- Georgia	90	90	100	100	120	120
Total Overhauls	410	430	460	760	510	850
Number of Bays	8	8	9	15	10	17

4. Description of the Existing Plant

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.

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.

4.3 Description of Workshops

4.3.1 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.

4.3.2 Blacksmith

At the Blacksmith shop rivets and bolts are dropforged.

The presses seem to be in good working order.

4.3.3 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.

4.3.4 Tank Repair Shop

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

4.3.5 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.

4.3.6 Balajari Washing Station

The Washing Plant for tank wagons is situated in the Baku suburb Balajari, and was built in 1937.

The steaming out of the interior of the tankers can be done at three tracks each containing 15 tank wagons. After the steaming, diesel oil and hot water with caustic soda is used to clean the residues within the tanks.

After the cleaning, the mix of oil and water is emptied directly down on the tracks leaving a huge pool of contaminated waste.

The plant for outside washing of the tank wagons is virtually a ruin, but as it is necessary to have the wagons cleaned before entering the Wagon Plant, it was decided the project should look into the possibilities of rehabilitating the exterior washing facilities.

At present 115 persons are employed at the Washing Plant and the planned capacity is 200 to 250 wagons per day.

5. Technical Solutions

5.1 Overview

Three different solution have been considered in order to present a reasonable range of alternatives.

The three solutions are:

a) Maintain the facility as it is, but repair as need arises,

b) Rehabilitation of the existing facility

c) Construction of a new facility

The railway does not support solutions a) and b). Solution a) will require close attention from the shop management in order to secure that no building parts are left in a condition where their collapse may endanger people or equipment.

5.2 Maintain the Facility as it is but Repair as Need Arises

In this solution, all holes in roof and wall are to closed. Structural members, mainly in the roof, which are worn out, must be replaced.

The wagon traverser must be rehabilitated, and the track in front of it adjusted so that derailment of wagons is avoided.

Machinery, presently not operational, should be made operational, when a business plan shows that they are needed for the further work of the plant.

A higher than usual, annual cost of maintenance of the building must be foreseen. This is partly due to the age of the building, partly due to lack of funds over the last few years and the resulting lack of maintenance.

Close attention must be paid by management to the state of building and equipment in order to prevent serious break-downs

At the washing station at Balajari, an impermeable floor shall be arranged, gathering the spills from the washing process. The run off shall be collected and treated in an oil separator. The oil shall be collected and taken to the refinery for reprocessing. This can be done either by truck or by tank wagon.

A cost estimate for the most needed repairs and renovations are:

US$, Cost level Mid 1995

Item	Unit	Cost (US$)
Building	jug.	1,300,000
Equipment	jug.	700,000
Washing plant	jug	1,500,000
Subtotal		3,500,000
Contingencies	20%	700,000
TOTAL		4,200,000

5.3 Rehabilitation of the Existing Facility

The reason for selecting this alternative is that the existing building, even in its dilapidated state, represents a value. A value which in the present, pressed economic situation, can be utilised to secure useful repair facilities The building is, therefore, repaired to an extend where it will be safe to work in and adequately protect equipment and wagons, taken in for repair. This will mainly consist of proofing the walls and roof against the elements in order to secure a dry, calm working area.

The floors need to be renovated as well. In order to save capital and to concentrate the work, it is proposed to renovate only the southern half of the floor, which will give sufficient capacity for the expected number of repairs. Should the optimistic prognosis necessitate a larger capacity than provided by working one shift in the renovated half of the plant, it will be possible to work two shifts to cover peak periods.

Furthermore, the washing plant at Balajari is repaired to ensure, over the long term, that serious environmental damage does not occur.

As a first measure, a general clean up of the area must be performed.

The structural members are left as they are with the exception of those, which are worn out and in need of replacement. Replacement is especially required of some of the roof members.

Roof and wall claddings are removed and new cladding installed. Electrical and mechanical installations are repaired to the extent necessary. Only the southern half will be fully equipped, while the northern half will be repaired only to a level of acceptable safety. All main lines, distribution switch gear etc. will be laid out so as to allow a later expansion to include the full facility.

The floor in the southern half of the facility is renovated. In the northern part, which should not be required for the time being, the floor is repaired to allow safe movement.

Equipment in need of repair and/or renovation will be classified and repaired in the order of priority, established through a survey.

A detailed survey must decide if the traverse should be repaired or if new tracks are to be laid in front of the shop in order to allow access to the repair bays. As long as only a limited number of bays are required, only those bays are to be provided with new track, if this is the solution chosen after further study.

At the washing station at Balajari, an impermeable floor shall be arranged, gathering the spills from the washing process. The run off shall be collected and treated in an oil separator. The oil shall be collected and taken to the refinery for reprocessing. This can be done either by truck or by tank wagon.

The cost is estimated at:

US$, Cost level Mid 1995

Item	Unit	Cost (US$)
Building	jug.	5,000,000
Equipment	jug.	3,500,000
Washing plant	jug	1,500,000
Subtotal		10,000,000
Contingencies	20%	2,000,000
TOTAL		12,000,000

5.4 Construction of a New Facility

5.4.1 Introduction

The railway commissioned the Ukrainian firm Giprozavodtrans Institute to carry out a preliminary design of a new tank wagon repair plant.

The cost of the plant was estimated by the Ukrainian firm at US$ 62 million. The consultant did a rough order of magnitude evaluation of this estimate. It is probably a little on the high side, but the order of magnitude is correct.

A translation of the programme for this complete rebuild is presented in Annex 1.

This complete rebuild is considered economically non-feasible at the present time, and a reduced first phase has been worked out in cooperation between the railway and the present consultant. In the following, the proposed first phase is described.

It shall be noted that the first phase does not exclude a later extension to the full project, if and when need so indicates and the funds can be made available.

5.4.2 Phase 1 of a Completely New Repair Shop

As previously indicated, the present consultant is of the opinion that the programme for a complete rebuild is too extensive to be feasible at the present time. But as a future target it is worth considering (especially on a new site outside the city).

It was therefore decided to prepare the programme for a first phase of this design in order to be able to evaluate the feasibility of constructing new facilities against the cost of repairing the old ones. This was done by the consultant in cooperation with the railway and with the assistance of Giprozavodtrans Institute.

The following is the minimum found necessary if one is to achieve the technological lift and the improvement in working conditions which must be the reason for selecting a new construction solution.

It was agreed to plan a first phase, comprising the following elements:

Demolishing of the existing main tank wagon workshop

Levelling of the ground

Change of track location

Reconstruction of a new main tank wagon workshop, model "long spans"

Demolishing of existing crane system on outside ware house

Reconstruction of the blacksmith on that area

Improvement of existing boiler-/compressor systems

Demolishing and reconstruction of washing plant for outside cleaning of tank wagons in Balajari

Improvement of welfare facilities

The floor areas involved are:

Tank wagon workshop 5600 sqm

Blacksmith 1358 sqm

Washing plant (outside) 1080 sqm

Cost Estimate
Giprozavodtrans Institute has prepared a budget estimate for as well the complete renovation project as for phase one.

The method seems to be standard in several CIS countries. A set of unit prices in Roubles 1984 cost level are indexed to 1991. They are then converted to the national currency (Manat) and indexed to 1996 cost level. At this stage they are converted into US$ at a rate of
1 US$ = 4,300 Manat. The method secures that estimates have the same basis, but the consultant consider it imprecise to cover a tender situation.

The estimate for the complete facility is, as previously mentioned, US$ 62 million.

The budget estimate of Giprozavodtrans Institute for the 1st phase, described above, is:

(Cost in US$)

Item	Building and civil works	Installation works	Equipment	Other expenses	TOTAL
Tank wagon workshop and blacksmith	11.632.900	3.407.000	7.785.900	2.960.000	25.786.200
Washing plant	1.626.700	257.200	661.000	277.400	2.822.300
TOTAL	13.259.600	3.664.200	8.446.900	3.237.400	28.608.500

The consultants estimate is as follows:

US$, Cost level Mid 1995

Item	Floor area (Sqm)	Cost (US$)
Tank wagon repair plant	5600	9,500,000
Blacksmith	1358	2,500,000
Machinery	N/A	4,500,000
Washing plant	1080	3,000,000
Subtotal		19,500,000
Contingencies	20%	4,000,000
TOTAL		23,500,000

This estimate has reduced the standard of the building proposed and assumed a wider reuse of equipment than the one prepared by Giprozavodtrans Institute.

6. Economic Evaluation

6.1 General Approach

This evaluation, which considers alternative ways to develop the workshop, is carried out in economic terms in which costs and benefits for the TRACECA Region as a whole are estimated (in mid 1995 prices), in terms of actual resources consumed rather than in terms of what particular railways pay. Therefore adjustments are made to recorded financial costs paid by the railways to remove transfer payments such as taxes and subsidies.

Following the economic evaluation, the financial implications of the project for Azerbaijan Railways are considered, to assess if the project would increase profitability or not.

The general approach assumes that a tank wagon workshop is essential in the Caucasus Region to provide capital repair services for tank wagons. It was one of only three such workshops in the railways of the former Soviet Union and the only such workshop in this part of the TRACECA Region. It established a good reputation and is well located for the maintenance of the tank wagon fleet required by the growing oil industry in Azerbaijan. It further assumes that the tank wagon workshop would be used for capital repair of other types of Azerbaijan wagons and for capital repair of tank wagons from other railways.

In accordance with this approach the evaluation seeks to identify the least cost option for developing the workshop, taking both capital and running costs of the workshops and wagon fleets of Azerbaijan and Georgia into consideration. Costs are considered over the long term, from 1997 to 2025, similar to the lifetime of the assets involved, and the current Net Present Value (NPV) of total costs is estimated by discounting the annual costs from mid 1996 at a rate of 12% per year (representing the economic opportunity cost of capital). Costs incurred over the first ten years or so, to 2008, are estimated separately for each year. Since only very approximate projections of costs can be made beyond that date, constant annual costs are assumed thereafter. This simplifying assumption is unlikely to affect the evaluation results strongly because of discounting.

Any potential benefits arising from increased profits from overhauling foreign wagons are also approximately estimated.

6.2 Options

The following three options are considered, as described in Section 5.1:

a) Continue as present - repairs to existing buildings from time to time on an ad-hoc basis leaving the present poor working conditions unchanged,

b) Rehabilitate the present tank wagon workshop and other related central wagon workshops to provide better and sustainable buildings and working conditions (described earlier in this report),

c) Construct new workshops to provide even better buildings and working conditions (the revised cost estimate proposal mentioned earlier).

6.3 Main Assumptions

6.3.1 Traffic Scenarios

The main traffic scenario used in the evaluation is based on the traffic forecasts of the main study: referred to as the pessimistic assumption in Section 3.1. An alternative optimistic forecast is also considered as described in the same section.

6.3.2 Railway Development

The following assumptions are made regarding railway development:

- productivity improvements in maintenance, greater under options (b) and (c) due to the better workshop conditions, (leading to staff reductions but increases in salary as assumed in the main study),
- continuation of same type of rolling stock for 10-15 years and then gradual replacement with modern technology (there is considerable potential for conversion of general wagons to tank wagons over the next 15 years to meet any growth in demand, but eventually more efficient wagons using modern technology could be justified),
- the tank wagon workshop is used for capital repairs of all Azerbaijan wagons and tank wagons from Georgia and other countries such as Russia and Armenia, and
- improvements in equipment utilisation are achieved as the surplus equipment is reduced and the improved workshop allows more efficient operating methods to be introduced.

6.3.3 Definition of Project Costs

The following capital and running costs are considered in the evaluation:

- capital cost of building construction work for the tank wagon works and for related workshops (only for the provision of essential environmental improvements to minimise contamination of ground water under option (a); for replacing the floor and roof and installing services under option (b); and for new construction under option (c)),
- capital cost of workshop equipment for replacing, at minimum cost in the short term, machinery which is inadequate for meeting current needs under option (a); and for a general upgrading of equipment under options (b) and (c),
- building and equipment maintenance costs (this is highest for option (a) because of the poor continued condition of the buildings and lowest for option (c)),
- wagon repair costs which are lower under options (b) and (c) because of lower maintenance staff numbers required in the workshop with a more efficiently designed layout (which in turn reduces costs of salaries, employment costs and overheads),
- repair costs of wagons in the TRACECA Region which are lower under options (b) and (c) due to better quality of capital repairs which reduces breakdowns, accidents and costs of lower level maintenance.

Possible additional benefits which could offset the costs of improving the workshop include improvement in worker health and safety (which in this simple evaluation cannot be quantified). It should be noted that possible savings in repair costs of wagons outside the TRACECA Region which are maintained in the workshop are not included in the benefits because these do not necessarily benefit the TRACECA countries. However if the workshop was able to attract more revenue from overhauling wagons from other countries then this would represent additional benefits to the TRACECA Region.

Note that possible wagon acquisition/rehabilitation costs could also be incurred after about 2005 and that improvements in the workshop, by minimising such costs, could achieve further benefits. However such benefits canot be reliably estimated so far into the future. They are unlikely to affect the evaluation because of discounting.

6.4 Estimation of Costs (at mid 1995 prices)

Project costs are described in Section 5. The capital cost of option (c) for both construction and equipment has been estimated in "Business-Plan for Construction of Baku Tank Wagon Repair Works", Giprozavodtrans, 1996, using 1984 Rouble prices converted to current Azerbaijan Manats by means of various indices and expressed in 1996 US$. Because the structure of prices would have changed considerably since 1984 and there would be doubt about the values of the conversion indices under high inflation conditions, this estimate must be considered as rather questionable. The cost, excluding equipment and taxes, is US$ 20.2 million. The equipment cost is estimated as US$ 8.4 million. Allowing for, say, 3% annual inflation this corresponds to US$ 19.6 million and US$ 8.2 million at 1995 price levels. Because much of the existing equipment would be replaced under this option, no further equipment purchases are assumed to be necessary for the next ten years. Then an annual allowance of US$ 0.3 million is assumed to be required to replace existing equipment.

The consultant has revised this estimate in view of the need for using prices which are likely to appear in international competitive bidding. This gives a building cost of US$ 12 million, a cost for renovating the washing plant at Balajari of US$ 3 million and an estimated cost of new equipment of US$ 4.5 million. To these figures are added 20% to allow for contingencies, adding up to a total of US$ 23.5 million.

The capital cost of option (b) is based on our estimate of replacing the roof and floor of the existing main building plus other similar improvements in other related buildings used for tank wagon maintenance, amounting to US$ 12 million, including building costs of US$ 5.0 million, equipment US$ 3.5 million, washing station US$ 1.5 million and contingencies US$ 2.0 million. Because less replacement of equipment takes place initially, annual equipment replacement costs of US$ 0.3 million are assumed for all future years.

The capital cost of option (a) includes minor building costs, assumed to be around US$ 1.3 million, equipment costs of US$ 0.7 million and US$1.5 million for renovation of the Balajari washing plant. An allowance for contingencies of 20 % is added. All amounts exclude taxes. Increased annual equipment replacement costs, of US$ 0.7 million, are assumed compared to option (b) due to the increased deterioration of equipment that would be expected under the poor conditions appertaining in the workshop, and the lower level of equipment replacement in the short term.

Annual average building maintenance costs are assumed to be 2% of the initial cost (excluding equipment costs) by 2008 for revised option (c) (that is US$ 0.36 million), increasing from zero in 1997 because of the reduced maintenance needs for a new building. The same maintenance cost is assumed in the long term for option (b), but the same amount is assumed even in the short term because the building is not new. Under option (a) there is a high risk (say 20% each year) of serious collapse of parts of the existing buildings which could require major repairs equal to 10% or more of the total reconstruction cost of the workshops (assumed conservatively to be equal to the initial cost of option (c)). It is assumed that such major repairs require on average 2% of the value of the reconstruction cost which, together with the cost of minor repairs, would require expenditure each year of about 4% of the reconstruction cost. Under these assumptions the average annual total building repair costs would be US$ 0.72 million.

Workshop equipment maintenance costs for options (b) and (c) are estimated at 5% of the initial value, taken to be US$ 8.5 million). Because of the inferior conditions expected under option (a), especially the continued leaking roof, equipment maintenance costs are assumed to be higher, at 7.5% of the initial value.

Maintenance staff costs have been estimated assuming that current staffing levels remain under option (a) but reduce to 90% and 80% of these under options (b) and (c) because of the increased productivity allowed by the redesigned workshops. It seems reasonable to expect less improvement under option (b) because there would be restricted space and the layout would be constrained due to the characteristics of the present building. Overheads are assumed to remain at 10% of staff costs for all options.

It is assumed that the increased quality of maintenance achievable with the improved workshop would reduce direct wagon repair costs, for spare parts and staff at all wagon workshops on the railways of Azerbaijan and Georgia. No reduction in overheads are assumed because of the time lag between reducing maintenance needs and the adjustments required by the railway to rationalise other facilities. Based on cost analyses performed as part of this study for railways in the TRACECA Region, it has been estimated that annual maintenance costs per wagon are US$ 1,100 and 600 for materials and staff respectively (based on a

material cost of US$ 0.016 per wagon km and 70,000 km per year, and 0.1-0.25 staff per wagon costing an average of US$ 235-350 per month). Most of this would be incurred through planned maintenance activities and it is assumed that only 30% of this is due to breakdown repairs which could be reduced through better quality capital repair: US$ 510 per wagon per year. It is assumed that this figure can be achieved only under option (c), while under options (a) and (b) breakdown repair costs would be increased by 5% and 10% respectively due to reduced quality of capital repairs.

The benefits to the TRACECA Region of increased profits arising from carrying out wagon overhauls for foreign railways in the workshop have been estimated based on the possible number of overhauled wagons and the possible increase in profits per overhaul. As described earlier, the number of foreign wagons (mainly from non-TRACECA countries) is expected to be about 50% of those from Azerbaijan and Georgia. Increased profits would mainly be derived from the higher quality of repairs in the improved workshops, which could allow higher charges to be levied. Depending on the competitive conditions in the region, the maximum increase in charge that foreign wagon owners would be prepared to pay could be equal to the expected reductions in direct wagon repair costs that they would enjoy as a result of the improved quality of overhauls. However it is assumed that in practice the scope for increasing charges would be only half this; that is the benefits are equally shared between the workshop and the wagon owner.

6.5 Comparison of Costs

The total NPV of each option (in US$ million) is shown in Table 1 below. The annual costs for each option are shown in additional tables in Annex 2.

Under the pessimistic scenario, Option (b) has the lowest total cost. Compared to Option (a), the NPV of running costs are significantly reduced by about US$ 7 million, which more than compensates for the higher capital costs of about US$ 4 million. In addition potential increased profits of about US$ 0.2 could be achieved.

Option (c) has the highest costs. Although running costs are reduced even further than Option (b), to about US$ 10 million, and potential profits are as high as US$ 0.4 million, this is outweighed by the additional capital cost of US$ 14 million.

The result is not sensitive to traffic level. Under the optimistic scenario, Option (b) is still clearly the least cost option and Option (c) the most expensive. The result is also not sensitive to the assumed discount rate of 12% - the same pattern of costs is found with a discount rate of 10% as shown in Annex 2.

Table 1 Summary of Net Present Value of Costs and Benefits for Each Option (US$ million)

Scenario	Option (a)				Option (b)				Option (c)			
	Continuing as at Present				Reconstructing Existing Workshop				Constructing New Workshop			
	Capital Costs	Running Costs	Total Costs		Capital Costs	Running Costs	Total Costs	Potential Additional Profits	Capital Costs	Running Costs	Total Costs	Potential Additional Profits
Optimistic	8.7	42.1	50.9		12.9	35.0	47.8	0.2	22.9	32.1	55.0	0.5
Pessimistic	8.7	36.2	44.9		12.9	29.3	42.2	0.2	22.9	26.7	49.6	0.4

NOTE (1) Estimated at mid 1995 prices, discounted from mid 1996 at 12%.

7. Conclusion

Since Option (b) appears to be the least cost option, this project should be further considered as the basis for the development of the wagon workshop over the medium term. A major investment in a new workshop is not justifiable at the present time, even if costs are minimised as suggested in this study. In any case it is questionable whether such a new workshop should be sited near the middle of town: there would be environmental and cost advantages in siting a new workshop outside the city area, such as using land of lower value, allowing the washing plant to be located closer to the workshop, and reducing environmental hazards to the community.

According to the financial evaluation in "Business-Plan for Construction of Baku Tank Wagon Repair Works", Giprozavodtrans, 1996, a new workshop could be regarded as self-financing if the workshop received appropriate remuneration from the railway for the services it rendered, especially if a reduced scale or revised project, as proposed under Option (c), was implemented. However the annual profits were projected to increase from only US$ 1.0 in 1997 to US$ 9.8 million in 2001, representing, for a projected cost of US$ 28.6 million, a financial return on investment which increases sharply from only 3.5% at present to an attractive 34.3% after four years.

The financial return for Option (b) is likely to be much higher, because it should be able to produce similar production levels for a capital investment of less than half that of Option (c). However even this Option may be difficult to finance unless traffic grows significantly. This implies that consideration should be given by the railway to securing finance from customers in the oil industry, who could reduce the risk of investment by guaranteeing minimum traffic levels.

From the financial point of view of Azerbaijan Railways, only if traffic increases greatly would a major investment in the Baku workshop be attractive and increase profitability. Under these conditions Option (b) is likely to be financially feasible at an earlier date than Option (c) because similar levels of maintenance and wagon cost savings would be achieved with much less capital investment. This suggests that a step by step development strategy, in which improvements are made as and when they can be justified by higher traffic levels, makes economic and financial sense. This conclusion is strengthened still further if consideration is given to the present difficulties of the railway in securing revenue for the traffic it carries. It seems unlikely that any investment in the workshop would be considered until such fundamental difficulties are resolved.

When the traffic prospects are clearer, the costs of Option (c) should be reviewed to establish the extent of possible cost savings. The possibility, in the long term, of relocating the workshop outside Baku could also be considered as a way of securing additional benefits from construction on less expensive land. This could offset at least some of the additional costs of this option.

Annex 1 : Programme for a Completely New Plant

Introduction

The railway commissioned the Ukranian firm Giprozavodtrans Institute to carry out a preliminary design of a new tank wagon repair plant.

The Consultant considered the complete programme to be non-feasible. In cooperation with the railway and Giprozavodtrans, a first phase programme was developed. This 1 phase is described in chapter 5 of this study, and its economic prospects in chapter 6.

In order to maintain all information on plans for the tank wagon repair shop in one document, a translation from Russian of the programme for the completely new plant follows.

Programme for the Future Plant

The railway expects a requirement to repair 2000 tank wagons annually. The consultant feels this is an optimistic forecast. There is, however, a need for repair of all other types of freight wagons. Since the renovated workshop can be used for repair of several types of wagons, it will be possible to utilise the capacity of the renovated plant.

The design material provided by Giprozavodtrans Institute contains the following main features:

- Keep the current specialisation of the works on the capital repair of the tank wagons.
- Conduct the reconstruction of the works within the current maintenance areas with technical re-equipment of the production;
- Remove the current building of the wagons workshop and blacksmith's and construct the new workshop, where to arrange the tank wagons repair department, the bogie department and assembling department;
- Arrange the washing, steaming and inside cleaning of the tank wagons in Balajari washing and steaming station. This business-plan considers the installation of new washing machinery;
- Reconstruct and enlarge the current frame workshop and arrange the blacksmith's within it;
- Move the thermic department from the current wagons workshop to the wheel department;
- During the reconstruction period, arrange temporary facilities in the pressure department for the repair of the tanks and bogies. After reconstruction, transfer the parts and details to the proper departments;
- Construct new painting department with the gasification facilities;
- Arrange the loco axles repair on the free areas of the axle department;
- Arrange the repair of the coupling heads in the areas of the current boiler department;
- Move the electric department to the breaking system department;
- Carry-out the capital repair of the small garage and arrange the electrocar garage;
- Build-up new electric control board for 6 kV;
- Build-up new communication system.;
- Replace the old boilers in the boiler department, model dkvr-6.5/13 by more economic one- de-10-14 gm.;
- Install two new compressors in the compressor department;
- Build-up the cleaning facilities and the fire pump station,
- Make the technical re-equipment of the rest of the workshops;
- Provide the energy saving facilities running on Swedish technology;

- Make the capital repair of equipment and electric engines in special enterprises of the city and in the works to make only the light repair;
- Make lifting and transport operations in the workshops by electric cars and bridge cranes.
- Arrange modern gas cleaning facilities:
- To detect the aerosols and gazes during welding, use the technology of the Swedish company - Plumex.
- To detect the solvents steams during the painting and drying process, use the technology of the Japanese company - Toyo Boseki.
- To detect the aerosols of the paints, use the technology of Ukraine institutes
- (use of the mono-threads) and Russian company-Vortex technologies (use of the Vortex reactive).

As previously indicated, the present consultant is of the opinion that this programme is too extensive to be feasible at the present time. But as a future target it is all right.

It was therefore decided to prepare the programme for a first phase of this design in order to, be able to evaluate the feasibility of constructing new facilities against the cost of repairing the old ones. This was done by the consultant in cooperation with the railway and with the assistance of Giprozavodtrans Institute.

Annex 2 : Estimated annual costs for each option

COSTS FOR DEVELOPING BAKU TANK WAGON WORKSHOP - OPTION A, PESSIMISTIC SCENARIO (US$ Million)

	Capital Costs		Recurrent Costs						
Year	Workshop Construction	Workshop Equipment	Building Maintenance	Equipment Maintenance	Staff	Overheads	Direct Wagon Repairs		
1997	3.36	0.84	0.72	0.41	0.99	0.10	1.86		
1998		0.70	0.72	0.41	1.02	0.10	1.89		
1999		0.70	0.72	0.41	1.06	0.11	1.92		
2000		0.70	0.72	0.41	1.10	0.11	1.94		
2001		0.70	0.72	0.41	1.14	0.11	1.97		
2002		0.70	0.72	0.41	1.18	0.12	2.00		
2003		0.70	0.72	0.41	1.23	0.12	2.03		
2004		0.70	0.72	0.41	1.27	0.13	2.06		
2005		0.70	0.72	0.41	1.32	0.13	2.09		
2006		0.70	0.72	0.41	1.37	0.14	2.12		
2007		0.70	0.72	0.41	1.42	0.14	2.16		
2008		0.70	0.72	0.41	1.47	0.15	2.19		
2009		0.70	0.72	0.41	1.47	0.15	2.19		
2010		0.70	0.72	0.41	1.47	0.15	2.19		
2011		0.70	0.72	0.41	1.47	0.15	2.19		
2012		0.70	0.72	0.41	1.47	0.15	2.19		
2013		0.70	0.72	0.41	1.47	0.15	2.19		
2014		0.70	0.72	0.41	1.47	0.15	2.19		
2015		0.70	0.72	0.41	1.47	0.15	2.19		
2016		0.70	0.72	0.41	1.47	0.15	2.19		
2017		0.70	0.72	0.41	1.47	0.15	2.19		
2018		0.70	0.72	0.41	1.47	0.15	2.19		
2019		0.70	0.72	0.41	1.47	0.15	2.19		
2020		0.70	0.72	0.41	1.47	0.15	2.19		
2021		0.70	0.72	0.41	1.47	0.15	2.19		
2022		0.70	0.72	0.41	1.47	0.15	2.19		
2023		0.70	0.72	0.41	1.47	0.15	2.19		
2024		0.70	0.72	0.41	1.47	0.15	2.19		
2025		0.70	0.72	0.41	1.47	0.15	2.19		
TOTAL	3.36	20.44	20.88	11.96	39.56	3.96	61.42	161.58	
NPV @ 12%	3.00	5.74	5.78	3.31	9.85	0.99	16.26	44.93	
NPV @ 10%	3.05	6.69	6.75	3.86	11.70	1.17	19.12	52.35	

COSTS FOR DEVELOPING BAKU TANK WAGON WORKSHOP - OPTION B, PESSIMISTIC SCENARIO (US$ Million)

	Capital Costs		Recurrent Costs						
Year	Workshop Construction	Workshop Equipment	Building Maintenance	Equipment Maintenance	Staff	Overheads	Direct Wagon Repairs		
1997	7.80	4.20	0.11	0.28	0.89	0.09	1.78		
1998		0.30	0.12	0.28	0.92	0.09	1.80		
1999		0.30	0.13	0.28	0.96	0.10	1.83		
2000		0.30	0.15	0.28	0.99	0.10	1.86		
2001		0.30	0.17	0.28	1.03	0.10	1.88		
2002		0.30	0.19	0.28	1.06	0.11	1.91		
2003		0.30	0.21	0.28	1.10	0.11	1.94		
2004		0.30	0.23	0.28	1.14	0.11	1.97		
2005		0.30	0.26	0.28	1.19	0.12	2.00		
2006		0.30	0.29	0.28	1.23	0.12	2.03		
2007		0.30	0.32	0.28	1.28	0.13	2.06		
2008		0.30	0.36	0.28	1.32	0.13	2.09		
2009		0.30	0.36	0.28	1.32	0.13	2.09		
2010		0.30	0.36	0.28	1.32	0.13	2.09		
2011		0.30	0.36	0.28	1.32	0.13	2.09		
2012		0.30	0.36	0.28	1.32	0.13	2.09		
2013		0.30	0.36	0.28	1.32	0.13	2.09		
2014		0.30	0.36	0.28	1.32	0.13	2.09		
2015		0.30	0.36	0.28	1.32	0.13	2.09		
2016		0.30	0.36	0.28	1.32	0.13	2.09		
2017		0.30	0.36	0.28	1.32	0.13	2.09		
2018		0.30	0.36	0.28	1.32	0.13	2.09		
2019		0.30	0.36	0.28	1.32	0.13	2.09		
2020		0.30	0.36	0.28	1.32	0.13	2.09		
2021		0.30	0.36	0.28	1.32	0.13	2.09		
2022		0.30	0.36	0.28	1.32	0.13	2.09		
2023		0.30	0.36	0.28	1.32	0.13	2.09		
2024		0.30	0.36	0.28	1.32	0.13	2.09		
2025		0.30	0.36	0.28	1.32	0.13	2.09		
TOTAL	7.80	12.60	8.66	7.98	35.60	3.56	58.68	134.88	
NPV @ 12%	6.96	5.89	1.79	2.21	8.87	0.89	15.54	42.15	
NPV @ 10%	7.09	6.36	2.20	2.58	10.53	1.05	18.27	48.07	

COSTS FOR DEVELOPING BAKU TANK WAGON WORKSHOP - OPTION C, PESSIMISTIC SCENARIO (US$ Million)

	Capital Costs		Recurrent Costs						
Year	Workshop Construction	Workshop Equipment	Building Maintenance	Equipment Maintenance	Staff	Overheads	Direct Wagon Repairs		
1997	18.00	5.50	0.00	0.28	0.79	0.08	1.69		
1998			0.01	0.28	0.82	0.08	1.72		
1999			0.01	0.28	0.85	0.08	1.74		
2000			0.01	0.28	0.88	0.09	1.77		
2001			0.02	0.28	0.91	0.09	1.80		
2002			0.03	0.28	0.95	0.09	1.82		
2003			0.05	0.28	0.98	0.10	1.85		
2004			0.07	0.28	1.02	0.10	1.88		
2005			0.11	0.28	1.06	0.11	1.91		
2006			0.16	0.28	1.09	0.11	1.93		
2007			0.24	0.28	1.13	0.11	1.96		
2008			0.36	0.28	1.18	0.12	1.99		
2009		0.30	0.36	0.28	1.18	0.12	1.99		
2010		0.30	0.36	0.28	1.18	0.12	1.99		
2011		0.30	0.36	0.28	1.18	0.12	1.99		
2012		0.30	0.36	0.28	1.18	0.12	1.99		
2013		0.30	0.36	0.28	1.18	0.12	1.99		
2014		0.30	0.36	0.28	1.18	0.12	1.99		
2015		0.30	0.36	0.28	1.18	0.12	1.99		
2016		0.30	0.36	0.28	1.18	0.12	1.99		
2017		0.30	0.36	0.28	1.18	0.12	1.99		
2018		0.30	0.36	0.28	1.18	0.12	1.99		
2019		0.30	0.36	0.28	1.18	0.12	1.99		
2020		0.30	0.36	0.28	1.18	0.12	1.99		
2021		0.30	0.36	0.28	1.18	0.12	1.99		
2022		0.30	0.36	0.28	1.18	0.12	1.99		
2023		0.30	0.36	0.28	1.18	0.12	1.99		
2024		0.30	0.36	0.28	1.18	0.12	1.99		
2025		0.30	0.36	0.28	1.18	0.12	1.99		
TOTAL	18.00	10.60	7.19	7.98	31.65	3.16	55.93	134.51	
NPV @ 12%	16.07	6.82	1.01	2.21	7.88	0.79	14.81	49.59	
NPV @ 10%	16.36	7.19	1.34	2.58	9.36	0.94	17.42	55.18	

COSTS FOR DEVELOPING BAKU TANK WAGON WORKSHOP - OPTION A, OPTIMISTIC SCENARIO (US$ Million)

	Capital Costs		Recurrent Costs						
Year	Workshop Construction	Workshop Equipment	Building Maintenance	Equipment Maintenance	Staff	Overheads	Direct Wagon Repairs		
1997	3.36	0.84	0.72	0.41	0.99	0.10	1.94		
1998		0.70	0.72	0.41	1.02	0.10	2.06		
1999		0.70	0.72	0.41	1.06	0.11	2.18		
2000		0.70	0.72	0.41	1.10	0.11	2.31		
2001		0.70	0.72	0.41	1.14	0.11	2.44		
2002		0.70	0.72	0.41	1.18	0.12	2.58		
2003		0.70	0.72	0.41	1.23	0.12	2.74		
2004		0.70	0.72	0.41	1.27	0.13	2.90		
2005		0.70	0.72	0.41	1.32	0.13	3.07		
2006		0.70	0.72	0.41	1.37	0.14	3.25		
2007		0.70	0.72	0.41	1.42	0.14	3.44		
2008		0.70	0.72	0.41	1.47	0.15	3.63		
2009		0.70	0.72	0.41	1.47	0.15	3.63		
2010		0.70	0.72	0.41	1.47	0.15	3.63		
2011		0.70	0.72	0.41	1.47	0.15	3.63		
2012		0.70	0.72	0.41	1.47	0.15	3.63		
2013		0.70	0.72	0.41	1.47	0.15	3.63		
2014		0.70	0.72	0.41	1.47	0.15	3.63		
2015		0.70	0.72	0.41	1.47	0.15	3.63		
2016		0.70	0.72	0.41	1.47	0.15	3.63		
2017		0.70	0.72	0.41	1.47	0.15	3.63		
2018		0.70	0.72	0.41	1.47	0.15	3.63		
2019		0.70	0.72	0.41	1.47	0.15	3.63		
2020		0.70	0.72	0.41	1.47	0.15	3.63		
2021		0.70	0.72	0.41	1.47	0.15	3.63		
2022		0.70	0.72	0.41	1.47	0.15	3.63		
2023		0.70	0.72	0.41	1.47	0.15	3.63		
2024		0.70	0.72	0.41	1.47	0.15	3.63		
2025		0.70	0.72	0.41	1.47	0.15	3.63		
TOTAL	3.36	20.44	20.88	11.96	39.56	3.96	94.30	194.46	
NPV @ 12%	3.00	5.74	5.78	3.31	9.85	0.99	22.20	50.87	
NPV @ 10%	3.05	6.69	6.75	3.86	11.70	1.17	26.61	59.83	

COSTS FOR DEVELOPING BAKU TANK WAGON WORKSHOP - OPTION B, OPTIMISTIC SCENARIO (US$ Million)

	Capital Costs		Recurrent Costs						
Year	Workshop Construction	Workshop Equipment	Building Maintenance	Equipment Maintenance	Staff	Overheads	Direct Wagon Repairs		
1997	7.80	4.20	0.11	0.28	0.89	0.09	1.86		
1998		0.30	0.12	0.28	0.92	0.09	1.97		
1999		0.30	0.13	0.28	0.96	0.10	2.08		
2000		0.30	0.15	0.28	0.99	0.10	2.20		
2001		0.30	0.17	0.28	1.03	0.10	2.33		
2002		0.30	0.19	0.28	1.06	0.11	2.47		
2003		0.30	0.21	0.28	1.10	0.11	2.61		
2004		0.30	0.23	0.28	1.14	0.11	2.77		
2005		0.30	0.26	0.28	1.19	0.12	2.93		
2006		0.30	0.29	0.28	1.23	0.12	3.10		
2007		0.30	0.32	0.28	1.28	0.13	3.28		
2008		0.30	0.36	0.28	1.32	0.13	3.47		
2009		0.30	0.36	0.28	1.32	0.13	3.47		
2010		0.30	0.36	0.28	1.32	0.13	3.47		
2011		0.30	0.36	0.28	1.32	0.13	3.47		
2012		0.30	0.36	0.28	1.32	0.13	3.47		
2013		0.30	0.36	0.28	1.32	0.13	3.47		
2014		0.30	0.36	0.28	1.32	0.13	3.47		
2015		0.30	0.36	0.28	1.32	0.13	3.47		
2016		0.30	0.36	0.28	1.32	0.13	3.47		
2017		0.30	0.36	0.28	1.32	0.13	3.47		
2018		0.30	0.36	0.28	1.32	0.13	3.47		
2019		0.30	0.36	0.28	1.32	0.13	3.47		
2020		0.30	0.36	0.28	1.32	0.13	3.47		
2021		0.30	0.36	0.28	1.32	0.13	3.47		
2022		0.30	0.36	0.28	1.32	0.13	3.47		
2023		0.30	0.36	0.28	1.32	0.13	3.47		
2024		0.30	0.36	0.28	1.32	0.13	3.47		
2025		0.30	0.36	0.28	1.32	0.13	3.47		
TOTAL	7.80	12.60	8.66	7.98	35.60	3.56	90.09	166.29	
NPV @ 12%	6.96	5.89	1.79	2.21	8.87	0.89	21.21	47.82	
NPV @ 10%	7.09	6.36	2.20	2.58	10.53	1.05	25.42	55.22	

COSTS FOR DEVELOPING BAKU TANK WAGON WORKSHOP - OPTION C, OPTIMISTIC SCENARIO (US$ Million)

	Capital Costs		Recurrent Costs						
Year	Workshop Construction	Workshop Equipment	Building Maintenance	Equipment Maintenance	Staff	Overheads	Direct Wagon Repairs		
1997	18.00	5.50	0.00	0.28	0.79	0.08	1.77		
1998			0.01	0.28	0.82	0.08	1.87		
1999			0.01	0.28	0.85	0.08	1.98		
2000			0.01	0.28	0.88	0.09	2.10		
2001			0.02	0.28	0.91	0.09	2.22		
2002			0.03	0.28	0.95	0.09	2.35		
2003			0.05	0.28	0.98	0.10	2.49		
2004			0.07	0.28	1.02	0.10	2.64		
2005			0.11	0.28	1.06	0.11	2.79		
2006			0.16	0.28	1.09	0.11	2.96		
2007			0.24	0.28	1.13	0.11	3.13		
2008			0.36	0.28	1.18	0.12	3.31		
2009		0.30	0.36	0.28	1.18	0.12	3.31		
2010		0.30	0.36	0.28	1.18	0.12	3.31		
2011		0.30	0.36	0.28	1.18	0.12	3.31		
2012		0.30	0.36	0.28	1.18	0.12	3.31		
2013		0.30	0.36	0.28	1.18	0.12	3.31		
2014		0.30	0.36	0.28	1.18	0.12	3.31		
2015		0.30	0.36	0.28	1.18	0.12	3.31		
2016		0.30	0.36	0.28	1.18	0.12	3.31		
2017		0.30	0.36	0.28	1.18	0.12	3.31		
2018		0.30	0.36	0.28	1.18	0.12	3.31		
2019		0.30	0.36	0.28	1.18	0.12	3.31		
2020		0.30	0.36	0.28	1.18	0.12	3.31		
2021		0.30	0.36	0.28	1.18	0.12	3.31		
2022		0.30	0.36	0.28	1.18	0.12	3.31		
2023		0.30	0.36	0.28	1.18	0.12	3.31		
2024		0.30	0.36	0.28	1.18	0.12	3.31		
2025		0.30	0.36	0.28	1.18	0.12	3.31		
TOTAL	18.00	10.60	7.19	7.98	31.65	3.16	85.88	164.46	
NPV @ 12%	16.07	6.82	1.01	2.21	7.88	0.79	20.22	55.00	
NPV @ 10%	16.36	7.19	1.34	2.58	9.36	0.94	24.23	61.99	

Kyrghyzstan'case studies :
Bishkek locomotive workshop modificaiton
Wheel workshop modification

Table of Contents

Annex 1 : Draft drawing of new loco workshop
Annex 2 : Draft drawing of extension of the existing loco workshop
Annex 3 : Plan of the new wheel workshop in Belovodskoe
Annex 4 : Main loco, list of spare parts
Annex 5 : Shunting loco, list of spare parts
Annex 6 : Freight wagons, list of spare parts
Annex 7 : Passenger wagons, list of spare parts
Annex 8 : Evaluation of the Modification of the Locomotive Workshop
Annex 9 : Evaluation of the Modification of the Wheel Workshop

1. Background

The Kyrghystan Railways are not fitted with the minimum infrastructure allowing them to get normal independence, the railway can not exchange a diesel engine by themselves, and the railway can not perform yearly maintenance of the locomotives by themselves. Furthermore the railway can not dismantle/assemble wheel sets by themselves.

That situation is costly in foreign currency and in transfer time which requires more spare locomotives and wheel sets and the situation also requires daily communication with other networks which again is time consuming and a limitation in autonomy.

TRACECA has decided to carry out two case studies concerning the above mentioned problems.

The consultant Mr Hasse Mortensen, DanRail Consult visited Kyrghystan Railways from 04.10.1996 to 13.10.1996 and again from 29.11.1996 to 22.12.1996. During the first visit a plan for the work to be executed was prepared, especially concerning the case studies about modernisation of the locomotive workshop in Bishkek and the wheel workshop. Mr. Ian Jenkins, project economist, participated in the first visit. Information needed to carry out the studies was identified and Kyrghystan Railways promised to have it prepared before the second visit.

The report contains general information to support the economic evaluation and a special chapter concerning spare parts is added to support the general spare part problem within the TRACECA countries.

The executive director asked the consultant to mention the Kazakstan project concerning changing of the old Russian diesel engines in the main locos to a new and modern American type (General Electric). He proposed TRACECA to arrange a study of this subject in Kyrghystan too.

During the second visit the consultant had the possibility to by train from Bishkek to Rabathi, to get an impression of the performance of the rolling stock and the infrastructure in operation.
The trip was undertaken on Friday 13 December There were two ordinary engine drivers on the loco (double unit, 6000 HP) to pull five passenger wagons. The train arrived punctually at the destination following the schedule all the way. There were no planned freight trains this morning to cross during the trip so the train only crossed was a scheduled passenger train in Tokmok. The maximum speed was about 40 to 60 km/h due to lack of track maintenance. All track switches were manually operated as the railway do not have centrally operated switches. Radio communication between train and operation centre is possible along the hole line.

The general impression of the rolling stock condition was that safety depended components were in acceptable condition but the comfort side suffered due to lack of maintenance and to the age. Even a point as cleaning was far below a minimum of acceptability.

Furthermore the consultant visited the Kazakstan loco workshop in Cho, with the objective of studying the facilities needed for Kyrghgystan Railways to carry out TR3/KR1 inspections by their own loco workshop in Bishkek.

All people met during the visits were co-operating with the consultant in a very open and friendly way.

2. General Information

To support further analyses a concentrate of information concerning annual figures from 1994-95 received from Kyrghystan Railways (annual report 1995) is shown below.

2.1 Freight and Passenger Transportation:

Type	Unit	1994	1995
Freight quantity	1000 ton	1422	909,5
Freight transported	mill ton km	628,9	404,1
Freight wagon km	mill km	10,3 (7,9 empty)	13,4 (9,3 empty)
Passenger transported	mill pass km	172,4	87
Passenger wagon km	mill km	8,5	7
Train/loco km	mill km	2,5	2,0

2.2 Repair and Maintenance of Rolling Stock:

According to the plan the following capital repairs were carried out

1 loco
39 freight wagons
28 passenger wagons

Depot repair of wagons

1036 freight wagons
341 passenger wagons

Total costs of capital repair were 18,114,000, which is 19,4% up from 1994.

2.3 Infrastructure Investment (1995):

Administration building in Kara-Balthi	1,732,000 som
Painting workshop	3,152,000 som
Administration and welfare building in Jalal-Abad	423,000 som

2.4 Traffic Irregularities:

There have been 20 occasions of small irregularities in 1995:

Organisation	1995	1994
Service and commercial department	4	5
Locomotive department	8	12
Freight wagon department	2	6
Track department	6	7
Signalisation department	-	1
Total	20	31

Main reasons for irregularities were derailments caused by poor condition of track.

2.5 Maintenance Cost Including the South Region (1000 som):

Consume area	Total 1994	Planned 1995	Result 1995
Salary	35,261	42,667	42,749
Materials	16,373	23,524	25,057
Diesel/oil	23,933	22,243	20,982
Electrical energy	1,779	2,284	2,188
Amortisation	1,689	1,787	1,611
Other	45,190	50,553	47,969
Total	124,225	143,058	140,556

The south region was connected to Kyrghgystan Railways in October 1994 so it is important to compare the results of railway work without the south region when comparing 1995 to 1994

Annual diesel consumption is 12,000 tons, plus 3% oil. One kg diesel costs 3 som

Maintenance cost, without the south region (1000 som)

Consume area	Total 1994	Total 1995
Salary	34,357	37,729
Materials	16,316	24,239
Diesel/oil	23,614	18,188
Electrical energy	1,746	2,032
Amortisation	1,663	1,501
Other	43,291	44,959
Total	120,987	128,648

The growth in salary at about 10% was to protect the workers against inflation. The growth in material cost was due to increase in spare part prices. Decrease in transportation volume brought a reduction of 23% of fuel consumption.

Average salary was 770 som against 636 som in 1994.

Total average staff during 1995 is by Kyrghgystan Railways given at a number of 5545 workers, whereof 4630 were occupied with main tasks (Operation, loco, freight, passengers, track, signalising and administration) and the rest with secondary tasks (laundry, housing, agriculture, kindergarten, etc.)

There is a minor difference between number of workers times average salary and total salary. No explanation for this diference was offered.

2.6 Incomes

Incomes from freight transportation (1000 som)

Type	1994	1995
Freight turnover	62,565	57,361
Refrain from using	-4,282	-2,350
Loading freight	7,425	3,577
Unloading freight	15,591	11,339
Additional income	21,245	23,439
5% income tax from transport	4,385	4,749
From forwarding firms	-	5,026
Other	27	1,074
Total	106,959	104,215

Incomes from passenger transportation (1000 som)

Type	1994	1995
Passenger transportation	9,238	7,909
Seat reservation	44,256	44,057
Baggage transportation	268	225
Mail transportation	2,408	5,097
Miscellaneous	-	2,072
Total	56,170	59,360

Total incomes from freight and passenger transport
1994 163,126,000 som
1995 163,575,000 som

Economical results covering 1995 and 1994 (1000 som)

Subject	1995		1994	
	in	out	in	out
Received income	229514		256320	
Tax		22179		41695
Production costs		172354		153277
Result of operation	34981		61348	
Other operational income	165		9	
Other incomes and expenses	17983	22094	49867	55067
Differences of exchanges	1591	5459	18256	32762
Total balance	31035		56157	

3. Modification of Bishkek Locomotive Workshop

3.1 General Information

The Bishkek loco workshop was constructed in two steps, the old part for carrying out lower level of maintenance and the newer part for carrying out TR1, TR2 and heavy repair. The old part was built in 1942 (1292 m^2)and the new part is from 1986 (1632 m^2).
The workshops contains work space for 9 main locomotives

Workshop equipment/machinery is sufficient to carry out work up to inspection level TR2.

3.2 Objective of the Study

Case study report, which enable immediate implementation of the modifications and which will evaluate the economic benefits of such an improvement.
Transfer of know how in workshop management.

3.3 Work Program

Evaluate the maintenance requirements in terms of yearly operations.
Evaluate the infrastructure modifications: raising of the walls and roof, pillars reinforcement, working platforms to be built.
Evaluate the workshop equipment to be purchased: cranes, trolleys
Perform an economic feasibility.
Define an implementation program.
Draw up a case study report

3.4 Short List of Basic Work to be Done in Connection with KR1 of Locomotives.

1. Diesel engine and secondary equipment.
Complete dismantling of diesel engine and secondary equipment with the test, repair and replacement of unsuitable parts e.g. antivibrator, vertical gear, conrod-piston group, fuel equipment, control of number of revolutions, air superchargers, turboblast-engine, filters, oil, fuel and water pumps, reductor gears with replacement of worn-out gears, connecting shafts, intermediate supports, measuring and protecting of devices, ventilators, cooling system, bolts etc.

2. Electrical equipment
For main generators and two unit sets
Dismantling and assembly of electrical machinery
Repair of pole coils
Repair of frames
Repair with restoration or replacement of cores, bearing shields etc.

Repair of mechanical part of rotors
Testing of electrical machinery and painting

3. Other electrical equipment and wiring.
Dismantling, repair and assembly of electrical machinery with replacement of unsuitable shunts, semiconductor elements, coils and other parts.
Replacement of unsuitable high voltage and low voltage wiring

4. Measuring and control instruments
Repair and test of Gauges, electrical Gauges and thermometers, thermorelays, amp.meters, voltmeters, tachometers, differential Gauges and relay of oil pressure.

5. Bogies.
Roll out, dismantling, repair and testing with replacement of unsuitable parts.
Repair and testing of axle boxes with replacement of seals.

6. Body and frame
Repair of supports, repair and testing of frame, replacement of unsuitable parts of body and roof, ladders, windows and doors.
Painting of locomotive.

7. Brake and pneumatic equipment.
Repair and testing of brake and pneumatic equipment with replacement of unsuitable parts.
Compressor with replacement of pistons and cylinders, casing, repair of jets, sandboxes.
Repair, washing and hydraulic testing of air reservoirs.

8. Equipment of general use
Repair and test of speedometers, automatic signalling equipment, radiosets and fire-protecting equipment

3.5 Main Technical Characteristics of Locomotive 2TE10B,M (For One Section).

transmission	diesel-electrical, direct current
Axle	3 - 3
Diesel engine capacity	2210 kW
Mass of one section	138 ton
Wheel diameter	1050 mm
Length of loco	16969 mm
Width of loco	3080 mm
Height of loco	4948 mm
Mass of fuel	6300 kg
- - oil	1500 kg
- - water	1450 kg
- - sand	1006 kg
Weight of main generator	8,9 ton
Weight of bogie	24,7 ton
Weight of wheel-motor	6,2 ton
Weight of wheel set	2,4 ton
Weight of diesel engine	20 ton
Weight of engine with generator	28,9 ton
Weight of force engine	3,8 ton

3.6 Locomotive Km-Production

Loco type	Train/shunting	1994	1995
Main loco	Freight train	950,000	851,000
	Pass train	1,034,000	921,000
Main loco total		1,984,000	1,772,000
Shunting	Shunting	423,000	366,000
	Other	24,000	20,000
Shunting total		447,000	386,000
Total		2,431,000	2,058,000

One shunting hour = 5 km

3.7 Estimated Numbers Of Locomotive Based On The Present Production (1995)

Main locomotives in operation produce about 400 - 500 km per day according to the railways statistical department. A yearly (1995) production of 1,772,000 loco km and an average of 450 km per day per loco, gives a need of 11 main locomotives ready for daily operation. The railway estimates 12 locomotives (two units). A reserve of 20% should be added to cover plant repair and operation reserve, which gives a total number of 15 main locomotives needed.

According to shunting plans a number of 12 shunting locomotives should be kept ready for daily operation. A reserve of 20% should be added which gives a total number of 15 shunting locomotives

3.8 Estimated Quantity Of TR3, KR1 And Unplanned Heavy Repair.

Main locomotives:
KR1 should be carried out after 720,000 km or 8 years, indicating a need of 2,5 KR1 per year increased to 3 to include unplanned repair.

TR3 should be carried out after 240,000 km or 16 months, indicating a need of (7,5-2,5) 5 TR3 per year.

Shunting locomotives:

KR1 after 7,5 years, which gives 15:7,5 = 2 KR1 per year increased to 3 including unplanned repair.

TR3 after 2,5 years, which gives 15:2,5 - 2 = 4 TR3 per year.

The figures can be summarised as follows:

Type of loco	Type of repair	Number per year	Man-hour per repair	Man-hour per year	Stand time days/repair	Stand time days/year
Main	KR1	3x2 = 6	8370	50220	12	72
	TR3	5x2 = 10	3500	35000	6	60
Shunting loco	KR1	3	7060	21180	12	36
	TR3	4	1625	6500	3	12
Total		23		112900		180

The total numbers of loco-stand-workdays per year is 180 days, which only requires one workplace (track) for one main/shunting loco unit within the workshop. To give some flexibility in the workprocesses it is recommended to calculate with a least space for one main locomotive (2 units).

One worker is able to deliver 2176 hours per year.
Number of workers required achieves 112900:2176 = 52 workers.
Average salary for one worker = 1170 som (level 96) without overhead.
The railway count with 260% overhead, covering the loco department only.

3.9 Transport Time and Costs (1996):

KR1 is only carried out by the loco workshop in Tashkent (Uzbekistan) for main as well as shunting loco and TR3 is carried out by the Kazakstan loco workshops in Cho or Jambul.

To transport one main loco (two units = 280 ton) from Bishkek to Tashkent (1000 km) and back takes 2x6 = 12 days and the cost is 2x2500 USD = 5,000 USD.

From Bishkek to Cho/Jambul (350 km) and back it takes 2x2 = 4 days and the cost is 2x160 USD = 380 USD for a main loco (two units).
Concerning shunting loco it is half price (one unit).

Price difference on transport to Tashkent compared to Cho/Jambul is caused by the agreement that locomotives shall arrive at Tashkent cold (special transport), where as at Cho/Jambul Kirgish Railway deliver the locomotives directly by their own drivers.

Kyrghystan Railway calculate with a cost of 300 som for each hour a locomotive (al types) is out of operation, based on the lost of average income of one locomotive in one hour (1996).

3.10 Price List (1996) of Repair by Foreign Workshops:

Type of loco	Type of repair	Tashkent	Cho	Jambul
Main loco	KR1	2,500,000 som	-	-
	TR3	-	870,000 som	870,000 som
	Transport	5,000 USD	320 USD	320 USD
Shunting	KR1	750,000 som	-	-
	TR3	-	130,000 som	130,000 som
	Transport	2,500 USD	160 USD	160 USD

The locomotives get their wheels turned in Jambul where the railway have an underfloor wheel-turning lathe. In 1996 the railway have turned 42 loco-wheel-sets at a total price of 199,000 som. The railway do not pay for the transport as they do it themselves.

KYRGHGYSTAN RAILWAYS charges 12,700,- som per day for renting out a main locomotive and 5,000,- som/day for a shunting loco.

3.11 Estimate of New Workshop Facilities:

As KYRGHGYSTAN RAILWAYS do not have any expertise incorporated in their organisation, concerning civil engineering, the railway have to depend on resources from outside. Normally they deal with the local technical and economical institute of civil construction as they did in context with the planification of the new freight wagon workshop in Belawodska. Concerning the modification of the locomotive workshop Mr Talasbaeiv could inform that the Institute has calculated the preliminary phase of a total project to cost about 20,000 USD. A total project description, included feasibility, required funds, work descriptions, detailed drawings, list of needed equipment/machinery etc., would cost about 80,000 USD.
A group consisting of representative from KYRGHGYSTAN RAILWAYS and the institute has been formed and they will start working as soon as the financial situation is cleared up. The members from KYRGHGYSTAN RAILWAYS are identical with the group which has coorporated with the consultant during the visit.

Equipment necessary in the Bishkek locomotive workshop to carry out TR3 and KR1

Item	quantity	price
Underfloor wheel turning lathe	1	
Stand for testing diesel generator	1	
Stand for testing electrical traction motor	1	
Stand for testing oil pumps	1	
Stand for testing compressor	1	
Crane (bridge), 30 tonne	1	
Lathe for turning commutators	1	
Stand for repairing main generator	1	
Stand for repairing main diesel engine	1	
Stand for drawling electrical machinery	1	
Furnace for drying insulation of electrical machinery	1	
Lift to support electrical machinery during dismantling/assembling	1	
Screw-cutting lathe	2	
Cross planning machine	1	
Slotting machine	1	
Milling machine (universal)	1	
Milling machine (vertical)	1	
Electrical jacks, 30 tonne	4	
Crane (bridge), 10 tonne	2	
Crane (bridge), 5 tonne	2	
Crane (bridge), 2 tonne	2	
Washing machine MM D 125	1	
Press for dismantling and assembling of auto-coupling	1	
Stand for mounting of cylinder shells	1	
Shelf for mounting of crankshafts	1	
Stand for handling of pistons with connecting rod	1	
Press for dismantling/assembling of electrical components	1	
Machinery for bandaging anchors and cleaning of commutators	1	
Machine for dynamically balance of anchor of electrical machinery	1	

The above mentioned list of machinery, stands, equipment etc., was made after a study trip to Kazakstan (Ous), to the locomotive workshop where the railway are able to carry out TR3 and KR1.
It was not possible to get valid prices during the visit.
The consultant estimate the total investment to be about 450,000,- USD.

The workshop has to comprise the following sub-workshops:

Workshop for dismantling and assembling of locomotive
Workshop for repairing of diesel engine
Workshop for repairing bogies
Workshop for electrical machinery

3.12 Construction of a New Workshop.

Kyrghystan Railways prefer construction of a new workshop to carry out TR3 and KR1. The workshop should secure the possibility of future maintenance of electrical locomotives.

A draft drawing was prepared during the visit and is enclosed as annex 1

The building comprises three tracks (one for dismantling/assembling of locomotives, one for handling bogies and one for handling diesel engines, total 4,320 m^2) and the above mentioned sub-workshops (3,888 m^2). The workshop comprises totally 8,208 m^2.

The price of the workshop is by Kyrghystan Railways (Construction Department) estimated at about 2.07 mill USD.

The new workshop including the necessary equipment and machinery will cost about 2.52 mill USD.

3.13 Extension of the Existing Workshop.

An extension of the existing loco workshop is possible but very difficult. The walls carrying the necessary 30 tonne crane need reinforcement (200,000,- USD). A draft drawing is enclosed as annex 2

It is necessary to construct new sub-workshops comprising 1360 m^2 at a price of 250,- USD/m^2 (which compared to european prices seems to be too cheep as we calculate with at least 700,- USD/m^2).
The total price of an extension of the existing workshop will be around:

enforcement of walls	200,000,- USD
equipment	450,000,-
workshops	340,000,-
Total	990,000,- USD

It was not possible to get any information concerning maintenance costs of infrastructure but an estimate of at least 2% per annum would not be too low.

3.14 Evaluation

To evaluate the modification to the locomotive workshop to allow KR1/2 and TR3 maintenance work to be performed, a comparison has been made of the following three options in terms of the capital and running costs of the workshop, and potential benefits of the modified workshop such as reduced transport and acquisition costs of locomotives sent to external workshops:

a) Continue as Present - sending locomotives from Kyrghyzstan to other workshops for TR3 and KR1 and higher maintenance, and for major repairs,

b) Modify Bishkek Workshop building and equipment to allow TR3 and KR1 maintenance and major repairs requiring engine to be lifted from the locomotives,

c) Build a new Bishkek Workshop with equipment to allow TR3 and KR1 maintenance and major repairs requiring engine to be lifted from the locomotives.

Various assumptions have been made in the evaluation as described in Annex 8. In particular, future traffic is assumed to grow as projected in the main study, and direct labour and material maintenance costs in Kyrghyzstan are assumed to be the same in neighbouring workshops in the TRACECA Region (so that these do not affect the results of the main evaluation). Sensitivity analyses have been performed to assess the effect of alternative assumptions, including the possibility of a higher rate of traffic growth.

The main evaluation is in economic terms in which costs and benefits to the TRACECA Region as a whole are considered both in the short term (1998) and long term (2008), excluding taxes and subsidies which are transfers within the economy rather than consumption of real resources. In addition the financial implications of the project for the profitability of Kyrghyzstan Railways are investigated.

As described in Sections 3.11 - 3.13, the capital cost for options (b) and (c) are US$ 1.44 million (15.8 million Som) and US$ 2.97 million (32.7 million Som) respectively. The annual overhead cost is estimated as 788,000 Som in 1998 and 945,000 Som in 2008 for both options as described in Annex 8.

The estimated annual benefits (in million of Som) of improving the Bishkek workshop are compared with annual overhead costs in the table below.

	Base Scenario	
	1998	2008
ANNUAL BENEFITS		
Transport Costs	0.70	0.70
Reserve Loco Costs	0.00	0.33 - 1.20
Administration Costs	0.07	0.07
Equipment Maintenance	0.25	0.25
Total Annual Benefits	1.02	1.35 - 2.22
ANNUAL COSTS		
Workshop Overheads	0.79	0.94
Total Annual Costs	0.79	0.94
NET ANNUAL BENEFITS	0.23	0.41 - 1.28

Reduced transport (and related administration) costs are major benefits arising from improving the locomotive workshop in Bishkek. In addition reduced equipment costs in other workshops in neighbouring countries are significant. In the long term the possibility of reducing reserve locomotive costs (through reducing time spent travelling between workshops and the need for additional spare locomotives in case of disruptions to maintenance services supplied by other railways) is another potential benefit. Annual benefits amount to about 1.02 in 1998 but increase in 2008 to 1.35 - 2.22. After subtracting workshop overhead costs, this gives an annual net benefit of 0.23 million Som in 1998 and 0.41 - 1.28 million Som in 2008.

For the modified workshop option costing 15.8 million Som, this represents an annual return in 1998 of 1.5%, rising to 2.6 - 8.1% in 2008. For the newly constructed workshop costing 32.7 million Som the annual return in 1998 would be 0.7% in 1998 and 1.3 - 3.9% in 2008.

The result is not very sensitive to the alternative assumption of higher freight traffic. Even with the higher freight traffic forecasts, the return would be very similar because most locomotives are used on passenger services and the numbers of KR1 and TR3 would only increase by about 5% (for about one extra locomotive). Benefits would increase by a correspondingly small amount. If, on the other hand, freight and passenger traffic continued to fall, then the case for the workshop would be even weaker.

The result would be very sensitive to the assumed workshop construction and equipment costs (which are to

a large extent based on Kyrghyzstan Railway estimates and appear to be rather low). Consequently the economic return of the modified workshop option could be less than estimated above.

From the financial point of view of Kyrghyzstan Railways, which does not suffer the consequences of the reduction in utilisation of existing maintenance facilities in other countries that would be caused by the improved Bishkek workshop, the project may seem more attractive. For example, as described in Annex 8, the short term variable financial cost (excluding capital costs of buildings and equipment) of the maintenance programmes carried out in Bishkek workshop could be reduced below current charges of other workshops, producing net annual savings to the railway (after transport, administrative and overhead costs) of between 1.2 and 3.6 million Som.

For the modified workshop option, this would represent an annual financial return on the investment of 15.8 million Som of 7-23% in 1998. The equivalent figures for the new workshop option would be only 4-11%. The results are rather sensitive to assumptions about the contract rates charged by external workshops (which include substantial profit margins of 100% or so, and could reduce if there is more competition between workshops in future years) and whether or not the VAT charged on the maintenance can be passed on by the railway to its customers (under reciprocal arrangements between Kyrghyzstan and neighbouring countries).

3.15 Recommendations

On the basis of these arguments it can be concluded that the economic return from investment in the new workshop is almost certain to be less than 5%, especially in the short term. Since this is below the minimum acceptable economic return normally applied (between 8 and 15%) the project is unlikely to be considered viable in economic terms. The modified workshop offers potentially higher economic returns of up to 8%, but this is still rather low and highly sensitive to assumptions about future construction costs, traffic levels and possible size of diesel locomotive fleet (which is affected by extent of locomotive utilisation improvements and by the possibility of electrification in future years).

This result reflects the current situation in the TRACECA Region that because of the present surplus workshop capacity and locomotives, expanding the Bishkek workshop simply increases overall maintenance costs for the Region as a whole. According to this analysis, while it may be justifiable to increase the range of equipment used in the Bishkek workshop, major investment in the specialised equipment required to perform KR1 and TR3 cannot be justified. Problems caused by the present situation, such as risks of disruption to maintenance services provided by external workshops and transport costs to/from these workshops, can be more economically solved through using additional locomotives as reserves, to be used if shortages occur of spares or locomotives.

The financial analysis generally confirms this conclusion. Based on reported contract prices, the financial return to Kyrghyzstan Railways for the modified workshop is reasonably high, suggesting that this project could possibly be funded from maintenance cost savings. However there is little prospect of being able to finance the new workshop under option (c). There is some uncertainty about future contract rates and the effect of taxation on financial returns. Therefore it is by no means clear that the railway would benefit financially from carrying out the KR1 and TR3 in the modified workshop. It could possibly lose money from carrying out this work in Bishkek if the actual construction cost was more than anticipated, if lower contract prices could be secured or if locomotive requirements continued to fall.

In view of these findings it is recommended that, to maximise benefits to railways in the TRACECA Region and to minimise investment risks, Kyrghyzstan Railways should

- continue to subcontract the KR1 and TR3 maintenance to external workshops,
- acquire sufficient tooling to enable it to carry out other, lower level locomotive maintenance,
- seek to negotiate better terms for the contracts, possibly through longer term contracts, and
- operate additional locomotives as reserves, if necessary, to insure against the risk of disruption to maintenance services.

4. Modification of Wheel Workshop

4.1 General information

The Kirgish Railways has made a business plan concerning a new workshop for repair of freight wagons including capital repair. It is situated 40 km from Bishkek in Belovodskoe in a former agriculture machinery plant. The Kirgish government offered the ground and the buildings to KYRGHGYSTAN RAILWAYS and the railway have started to prepare and implementate the workshop. The railway have already cleaned up indoors, laid a new floor with three tracks and at present the railway are connecting the tracks with the mainline. A drawing of the workshop is enclosed as annex 3.

A new wheel lathe (second hand) is ordered and expected delivered by the end of 1996. A plan for implementation of the new lathe has been prepared and staff appointed to dismantle/assemble the machinery and to be trained in operation.

The railway intend to continue wheel-turning in the old wheel workshop at the passenger wagon workshop, just to cover the need of this workshop. If the financial situation does not allow the railway to establish the new wheel workshop in Belovodskoe with new (second-hand) equipment, the railway will consider moving the machinery from the old wheel workshop to the new one.

The new wheel workshop is also planned to include machinery to dismantle and assemble wheel-sets.

4.2 Objective of the study

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 Kirgish Railways are not fitted with powerful equipment to assemble and dismantle wheels on axles or rings on wheels, therefore , the railway have to purchase from foreign countries the complete axles with wheels, which is costly since the axles themselves are not worn.

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).

4.3 Work Programme

Evaluate the maintenance requirements in terms of yearly operations.
Evaluate the infrastructure modifications.
Evaluate the workshop equipment to be purchased: crane, lathe, press
Perform an economic feasibility.
Define an implementation program.
Draw up a case study report

4.4 Present Wheel Workshop

The passenger wagon workshop (PWW) has a wheel turning workshop (about 40 years old machinery), with a capacity of 30 wheel-sets per day (1 shift = 11 hours).

It consumes 5202 man-hours to turn 636 wheel-sets, 1 wheel-set = 8,2 man-hours

Wheel-turning figures for 1995 and 1996 (wheel-sets)

Type of wagon	1995	1996 (11 months)	1996 estimate
Loco		4	4
Passenger wagon	2263	1950	2127
Freight wagon	4279	4923	5370
Total	6542	6877	7501

23 wheel-sets have been sent to Almaty/Cho in 1996 for reconditioning in connection with capital repair of pw. Price for one reconditioned wheel-set = 37,980 som.

Price for a new wheel-set = 60,000,- som (3,530 USD)

There are about 450 wheel-sets waiting for dismantling/assembling.

The railway have two trucks for transport of wheel-sets between the wheel workshop and the freight wagon workshop (fww), each loading 4 sets. A freight wagon can load 19 sets, fewer loco wheel-sets because of their gears.

Amount of wheels to maintain:

Main-loco 12, plus reserve 3 = 15	15x6 =	90
Shunting 12, plus reserve 3 = 15	15x6 =	90
Passenger coaches : 300	300x4 =	1200
Freight wagons : 2000	2000x4 =	8000
Total		9380 wheels

4.5 Estimate of Wheel Production

Based on the above mentioned operational requirement, the amount of 9380 wheel-sets have to be maintained yearly.

All passenger and freight wagons are equipped with monoblock wheel discs. From new to useless it is possible to turn off 40 mm, after that change of wheel-disc is necessary. The axle has a life time of about 20 - 25 years.

Assuming that 1996 is typical for the need of wheel-turnings to keep 9380 wheel sets running, it is possible to estimate the lifetime of a wheel-set. Average time between two turnings of a wheel-set is about 9380:7500 = 1,25 years.

On average the railway turn off approximately 5 mm by each wheel-turning, which gives 8 wheel-turnings during the lifetime of a wheel-disc.

The average lifetime of a wheel-set can be estimated at 1,25x8 = 10 years, before the discs have to be dismantled and new discs assembled.

Based on this, the amount of wheel-sets per year to dismantle/assemble will be about 9380 : 10 = 938 sets.

4.6 Costs of Wheel-Set Dismantling/Assembling and Transport Outside Kyrghystan.

The price of the transportation of one freight wagon with 20 wheel-sets from Bishkek to Almaty (present workshop with which the railway have a contract on wheel-set dismantling/assembling) is as following:

Bishkek - Lugovaya =	152 km =	1640 som
Lugovaya - Almaty =	433 km =	3366 som
Total		5006 som
Total incl. 20% tax		6007 som

Bishkek - Almaty -Bishkek = 2 x 6007 som for 20 wheel-sets = 12014 som.
One wheel-set = 12014 som : 20 = 601 som.

The price of dismantling/assembling included wheel turning of one wheel-set in Almaty = 9300 som (incl. tax), it was not possible to get a differentiated price on components.

4.7 Necessary Machinery to Dismantle/Assemble Wheel-Sets in Bishkek

The wheel workshop need to be furnished with the following machinery to cope with dismantling/assembling of wheel-sets:

Hydraulic press to dismantle/assemble wheel-discs.
Lathe for turning of axles.
Lathe for turning of disc hubs.

The railway have invited offers from Russia:

Hydraulic press model	116738 "Pressmask"	Odessa	10 mill som
Axle lathe	UBB-112/3	Kramatorsk	5 mill som
Disc lathe	KS-12 "Merry goes around"	Krasnodar	5 mill som

The prices were confirmed while the consultant was present

4.8 Capacity.

The capacity concerning dismantling/assembling of wheel sets with the above mentioned machines would be:

Hydraulic press 16 wheel sets per day per shift (8 hours)
Axle lathe 16 axles per day per shift (8 hours)
Disc lathe 16 discs per day per shift (8 hours)

This gives a capacity of 8 wheel sets per day and with one worker operating each machine (8 hours per shift) it will take 2 man-hours to produce one wheel set (dismantling/assembling).

The consumption of man-hours to turn the wheel sets for running, Kyrghgystan Railways informed that the railway consume 5,202 man-hours to turn 636 wheel sets traditionally, which give an average of 8,2 man-hours/wheel sets.

The total man-hour consumption including wash of wheel sets, dismantling/assembling of roller-bearings, control, dismantling/assembling of wheel sets and wheel-turning will be 10,2 man-hours.

4.9 Evaluation

To evaluate the modification to the wheel workshop to allow disassembly of used wheel sets and reassembly with new components, a comparison has been made of the following two options in terms of the capital and running costs of the workshop, and potential benefits of the modified workshop such as reduced transport and inventory costs of wheel sets sent to external workshops:

a) Continue as Present - sending wheels sets from Kyrghyzstan to other workshops for disassembly/reassembly for wagons, coaches and locomotives,

b) Expand, with wheel set disassembly/assembly equipment, the new wagon repair shop at Belavodskoe, currently under construction, to carry out all planned wagon and coach wheel replacement in Kyrghyzstan (and, when needed, repair locomotive wheel sets)

Various assumptions have been made in the evaluation as described in Annex 9. In particular, future traffic is assumed to grow as projected in the main study, and direct labour and material maintenance costs in Kyrghyzstan are assumed to be the same in neighbouring workshops in the TRACECA Region (so that these do not affect the main evaluation). Sensitivity analyses are performed to assess the effect on the evaluation results of alternative assumptions, including the possibility of a higher rate of traffic growth.

The main evaluation is in economic terms in which costs and benefits to the TRACECA Region as a whole are considered both in the short term (1998) and in the long term (2008), excluding taxes and subsidies which are transfers within the economy rather than consumption of real resources. In addition the financial implications of the project for the profitability of Kyrghyzstan Railways are investigated.

The cost of the modified workshop is estimated to be 22 million Som, including the equipment described in Section 4.7, and the cost of modifications to the building and services. The annual overhead costs of the workshop are projected to be 1.03 million Som. The annual benefits are compared with annual costs in the table below.

	Base Scenario		High Growth Scenario	
	1998	2008	1998	2008
ANNUAL BENEFITS				
Transport Costs	2	2	2	3
Inventory Costs		26 - 1,200		31 - 1,440
Administration Costs				
Equipment Provision	1	1	1	1
Total Benefits	1	1,868-3,042	1	1,936-3,345
ANNUAL COSTS				
Workshop Overheads	1	1	1	1
Total Annual Costs	1	1	1	1
NET BENEFITS	7	838 - 2,012	8	906 - 2,315

A major benefit of modifying the workshop is that less workshop equipment has to be provided and maintained in workshops in neighbouring countries. In addition there are significant transport cost (and associated administrative cost) savings moving wheel sets between Bishkek and these other workshops. Annual benefits increase as the amount of freight traffic is projected to grow (and are higher for the high traffic growth scenario).

However after subtracting workshop overhead costs, net annual benefits are about 0.8 million Som in 1998 and between 0.8 and 2.0 million Som in 2008, which implies a low annual return on the 22 million Som investment of 3.6% in 1998 and between 3.6 and 9.1% in 2008. This estimated return is rather low and so the project may not be considered viable in economic terms except under the most favourable conditions. This result is not particularly sensitive to traffic level: even under the high growth scenario the annual return remains at between 4.1 and 10.5% in 2008.

The result is much more sensitive to the degree to which

- a security reserve of wheel sets would be established by the railway if it continues to subcontract the wheel assembly/disassembly work to external workshops, and
- cost savings can be achieved through rationalisation of equipment and other fixed costs in other workshops which currently perform the wheel assembly/disassembly work for Kyrghyzstan Railways.

It is possible that the proposed workshop would only be able to be justified economically if traffic grows more than assumed in the moderate traffic scenario, if the railway intends to establish a significant security reserve of wheel sets, and if the required workshop equipment can be acquired second-hand from other railways (thus minimising the duplication of equipment on TRACECA railways).

However from the financial point of view of Kyrghyzstan Railways, which does not suffer the consequences of the reduction in utilisation of existing maintenance facilities in other countries that would be caused by the new Belavodskoe workshop, the project may seem more attractive under a wider range of assumptions.

For example the variable financial cost (excluding depreciation of buildings and equipment) of the wheel set disassembly/assembly work carried out in the Belavodskoe workshop could be reduced below current charges of other workshops as shown in Annex 9. This could allow an annual financial saving to the railway (net of transport charges, administration and overhead costs) of between 5.0 and 10.2 million Som, representing an attractive financial return of 23-46% on the 22 million Som investment. This high level of return suggests that the Kyrghyzstan Railways could finance the capital expenditure required for the project quite comfortably from the maintenance cost savings.

However current charges for wheel disassembly/assembly appear to be excessively high, possibly because of the use of standard pricing formulae which impose uniform levels of overheads irrespective of actual costs incurred. It is possible that, once contract prices are more closely related to actual costs, the financial advantages to the Kyrghyzstan Railways would be much less than estimated above.

4.10 Recommendations

Although, in economic terms, the project may not be viable except under certain conditions described above, it seems an attractive project when viewed from the point of view of the railway, especially since it could offer a reliable supply of wheel sets at lower cost than it currently pays. The railway is likely to continue to face considerable uncertainty, for example, due to possible reductions in potential suppliers of wheels sets (especially since Kazakhstan Railways is experiencing financial problems) and due to shortages of wheel sets that may occur due to difficulties obtaining foreign exchange (until the economic situation improves).

In order to maximise the benefits of the project, it is recommended that consideration be given to minimising costs through acquisition of second-hand equipment (especially from other TRACECA railways, in order to avoid wasteful duplication). Meanwhile it is recommended that Kyrghyzstan Railways try to negotiate lower rates for the wheel assembly/disassembly work and, if lower rates can be obtained, reassess the potential financial savings before finally embarking on the wheel workshop project.

5. Procurement of Spare Parts

Daily lack of spare parts is the main reason why Kirgish Railways has problems keeping their fleet of rolling stock in operation. Few spare parts are available in Kyrghystan and most of them are only concerning passenger wagons. KYRGHGYSTAN RAILWAYS came up with the below list of local enterprises of spare part/materials:

Name of company	Items
Joint venture "Zaralu"	Cast iron shoe
Organisation "Aalam"	Electronic
Joint stock company "Orgpriminstrument"	Cutting tools (milling, drills etc.)
J.S.C. "Pressmetall"	Electric boiling titan
Firm "Anubus"	Transformation of feeding luminescent lamps
Firm "Universal"	Aluminium handles, plastic/glass components
Bishkek auto repairing plant	Rubber components
Firm "Dostan 12"	Extinguisher of oscillation
Private businessman	Gussets, wedge
Firm "Fasad"	Bolts, nuts etc.

Assuming that the fleet of rolling stock needed to run the present traffic comprises:
15 main locomotives
15 shunting locomotives
2000 freight wagons and
300 passenger wagons
it was decided to estimate the average consume of spare parts concerning each type of inspection (TR1, TR2, TR3 and KR1) of each type of rolling stock.

The lists are enclosed as annexes:

Main loco, annex 4
Shunting loco, annex 5
Freight wagons, annex 6
Passenger wagons, annex 7

Annex 8 : Evaluation of Modification of Locomotive Workshop

Background

Kyrghyzstan railways consists of two independent sections. The main section of 322.7 km is centred on Bishkek in the north was part of the railways of southern Kazakstan; the other section is 101.2 km of branch-lines, centred on Jalalabad, which were part of the Uzbekistan railways. The two sections are not connected physically within Kyrghyzstan and the shortest distance by rail between Bishkek and Jalalabad is 1283 km.

General Approach

This evaluation is carried out in economic terms in which costs and benefits for the TRACECA Region as a whole are estimated, in terms of actual resources consumed rather than in terms of what particular railways pay. Therefore, where possible, adjustments are made to recorded financial costs paid by the railways to remove transfer payments such as taxes and subsidies.

To achieve efficient use of capital, the Kyrghizstan Government, would favour projects which can give high economic returns. Like other governments and international development agencies, projects which offer low economic returns would be expected to be given lower priority. It is not uncommon for minimum economic rates of return to be required before international finance is used for projects. Depending on the economic circumstances of the country, this minimum return commonly varies between 8 and 15%.

The financial implications for Kyrghizstan Railways of the project are also estimated at the end of the evaluation to assess if the project would increase profitability or not. For this financial evaluation, no adjustments are required to recorded costs.

The evaluation has involved making numerous assumptions, many of which could not be accurately verified. For this reason the results should be interpreted with care. Sensitivity analyses are performed to assess the likely effect of the major uncertainties.

Options

a) Continue as Present - sending locomotives from Kyrghyzstan to other workshops for TR3 and KR1 and higher maintenance, and for major repairs

b) Modify Bishkek Workshop building and equipment to allow TR3 and KR1 maintenance and major repairs requiring engine to be lifted from the locomotives

c) Build a new Bishkek Workshop with equipment to allow TR3 and KR1 maintenance and major repairs requiring engine to be lifted from the locomotives.

Main Assumptions

Traffic Scenarios

To evaluate workshop improvements, a long term evaluation period must be considered, comparable to the lifetime of the assets involved (typically 20 years for workshop equipment and even longer for buildings). To assess the long term impact of the proposed improvements, annual benefits are estimated for two years: the first year in which the improvements are made (1998 assuming immediate implementation) and the middle of the expected life of workshop assets (2008, assuming a life of 20 years).

The base traffic scenario assumed in the evaluation is that used in the main study, which is referred to here as the medium growth scenario:

- **medium** growth in freight traffic (constant up to 2000 and then 10% higher in 2005) which implies an annual growth of about 2% per year in proportion to 1995:1.0, 1998:1.00 and 2008:1.16, and passenger traffic remaining constant.

In addition a higher growth scenario is considered when assessing the sensitivity of the evaluation results to traffic level:

- **high** growth in freight traffic (a recovery in the short term followed by faster long term growth, in proportion to 1995:1.0, 1998:1.25 and 2008:1.75) and passenger traffic remaining constant (based on views of the railway),

Railway Development

The following assumptions have been made concerning the future railway development:

- no electrification during project evaluation period (which would reduce the need for workshop capacity),
- productivity improvements in maintenance both in Kyrghyzstan and abroad (leading to staff reductions but increased salaries),
- continuation of same type of rolling stock for about ten years and then gradual replacement with modern technology (there is considerable excess capacity which can be used for many years to come but eventually this would be replaced with more efficient, modern technology),
- no major change in motive power type (e.g. introduction of diesel multiple units),
- improvements in equipment utilisation above historic levels as the surplus equipment is reduced and efficiency improvements are made,
- rolling stock in south of country to be maintained in Uzbekistan to avoid excessive transport costs of rolling stock to/from Bishkek,
- economic maintenance costs (for labour and materials, excluding fixed overheads for buildings and equipment) are the same in all workshops in the region.

Other

- Exchange rate in mid 1995 of US$ 1 = 11 Som (which remained fairly unchanged during most of 1996).

Definition of Project Costs

The following project costs have been considered in the evaluation:

- capital cost of building construction work,
- capital cost of crane and other equipment required for the planned maintenance work (TR3 and KR1),
- additional overheads for building and equipment maintenance costs, heating and lighting and headquarters costs (in excess of that required for the existing workshop).

Definition of Project Benefits

The following potential benefits have been considered in the evaluation:

- reduction in transport costs of locomotives to other workshops (for both routine maintenance and major repairs),
- reduction in reserve locomotive costs due to reduced time spent by locos travelling to/from other

workshops (for both routine and repair maintenance) and any additional locomotives required for security reasons,

- reduction in administrative costs involved in handling contracts for maintenance at external workshops,
- possible reduction in maintenance costs from increased competition in maintenance services in the region (perhaps at depots outside Kyrghyzstan which are nearer to Bishkek than to any other workshop offering TR3 and KR1 maintenance, if maintenance costs at Bishkek are competitive with other workshops),
- reduced acquisition cost of maintenance equipment at workshops outside Kyrghyzstan because of the reduction in maintenance work on Kyrghyzstan locos (unlikely because of the general excess workshop capacity).

Estimation of Project Costs (mid 1995 prices)

Modify Existing Workshop

According to Section 3.13 the project cost is about US $ 1.44 million (15.8 million Som), consisting of:

Item	Amount (US$)
Enforcement of Walls	200,000
Additional Equipment	900,000
Construction of Component Workshops	340,000
TOTAL	1,440,000

The estimated building cost is very low by international standards and it is possible that in practice the cost could be 2-3 times higher.

Annual building and equipment maintenance costs are assumed to be required for the additional component workshops but not for the modified main workshop. It is estimated that this would be about 2% of the initial cost of US$ 0.34 million (that is 75,000 Som).

The additional annual equipment maintenance cost is estimated as 5% of the value of equipment, that is 495,000 Som.

In addition the heating and lighting costs for the component workshop are estimated to be roughly 75,000 Som per year.

Other additional fixed costs are assumed to be incurred at headquarters, caused by the additional range of maintenance activities undertaken. This is estimated as 10% of the expected staff cost (52 staff at 1,170 Som per month according to Section 3.8), allowing for 40% for social insurance costs and 40% for bonuses and other staff payments. This gives an average annual overheads cost of 143,000 Som in 1998, rising to about 300,000 Som in 2008 as real salaries increase.

The total annual overhead cost of running the modified workshop is therefore estimated as 788,000 Som in 1998 and 945,000 in 2008.

Construct New Workshop

This is estimated to cost US$ 2.07 million for building construction plus US$ 0.90 million for equipment acquisition (22.8 and 9.9 million Som respectively). As mentioned above, the construction cost could be 2-3 times higher than this.

The additional overhead costs are assumed to be the same as for the modified workshop - 788,000 Som in 1998 and 945,000 in 2008 (although in practice these costs are likely to be higher because of the greater increase in workshop capacity under this option).

Estimation of Project Benefits (mid 1995 prices)

Transport Cost Benefits

The average distance from Bishkek to external workshops varies from 271-282 km for TR3 maintenance at Jambul or Chu (for shunting and mainline locos respectively) up to 683 km for KR1 maintenance, for both loco types, at Tashkent. This implies an average round trip distance for locomotives for planned maintenance of 2*(2*280+683)/3=830 km assuming two TR3 for every one KR1. The same average distances are assumed for unplanned heavy repairs.

Transport costs to other workshops is assumed to be 30 Som per loco unit km. That is, double/triple unit locomotives would be double/triple this. The rate per unit is based on a nominal economic cost (excluding taxes) of medium distance rail transport (with no empty running) of 0.2-0.3 Som per tonne km and an average unit weight of 125 tonnes.

This is similar to some actual charges although, in some cases as described in Section 3.9, much lower charges are made because the locomotive can be moved under its own power with its own driver.

The number of locos in daily use at Bishkek depot in 1995 was 12 mainline and 12 shunting locos. Allowing for maintenance spares this implies an active fleet of 15 locos of each type. According to the estimates in Section 3.8 this would require 2.5 KR1 and 5.0 TR3 for mainline locos per year, and 2 KR1 and 4 TR3 for shunting locos at present.

According to the assumed medium growth traffic scenario, the fleet requirement would remain the same in 1998. By 2008, total freight traffic on the railway would increase from 404.1 m tonne km to 469.0 m tonne km (by a factor of 16%). Based on operating trains with 2,500 net tonnes with one (double unit) locomotive, in 2008 this would require 188,000 locomotive km per year (or about two freight locomotives, the same number as used at present). With no increase in passenger traffic, the active mainline locomotive fleet would remain at 15 (or less if passenger locomotive utilisation increased). For the total of 188,000+921,000=1,109,000 loco km operated, the number of KR1 and TR3 would be similar to (or less than) that needed at present. Increased operation of trainload freight trains which avoid marshalling activities could also decrease the number of shunting locos: but the number of KR1 and TR3 is assumed to remain the same.

The annual economic benefits in 1998 and 2008 from savings in transport costs are summarised in the following table (where 30% additional visits to workshops for unplanned repairs are assumed).

	Shunting Locos		Mainline Locos		All Locos	
	1998	2008	1998	2008	1998	2008
Number of Locos in Fleet	15	15	15	15	30	30
Number of Units in Fleet	15	15	30	30	45	45
Visits of Units to Workshops						
- Routine Maintenance	6	6	15	15	21	21
- Unscheduled Repairs	2	2	5	5	7	7
Total Visits	8	8	20	20	28	28
Unit km Operated/Visit	830	830	830	830		
Unit km Operated/Year	6,6	6,6	16,6	16,6	23,2	23,2
Transport Cost per Year (Som)	199,2	199,2	498,0	498,0	697,2	697,2

Reserve Locomotive Cost Benefits

The number of days spent by a locomotive travelling to and from the workshop is reported to be 4-12 days for the round trip to the workshops used by Kyrghyzstan Railways. An average of six days per visit is assumed for this evaluation for 1998. However it is assumed that this excessive time can be reduced to only three days by 2008. The number of spare units that are needed to cover for the time spent on these visits has been estimated assuming 300 operating days per year, as described below.

	Shunting Locos		Mainline Locos		All Locos	
	1998	2008	1998	2008	1998	2008
Visits of Units to Workshops	8	8	20	20	28	28
Lost Unit Days	48	24	120	60	168	84
Spare Units Required	0.16	0.08	0.40	0.20	0.56	0.28

The number of required spare units is generally insignificant, especially in 1998 when there are numerous excess locos available. Even in 2008 when the equivalent of 0.28 units are required, it is doubtful whether an additional unit would be purchased, it is more likely that existing locos would be used as reserves.

For example, the annual economic cost of maintaining one main line loco is US$ 59,000 (for labour, materials and overheads but excluding taxes and profits) according to Table 2.4 of the main study, assuming that a full programme of periodic maintenance is carried out. This is equivalent to US$ 30,000 (0.33 million Som per locomotive unit). By contrast, acquisition of a new locomotive unit would be much higher: at an estimated cost of US $ 1.0 million per unit, the annual amortisation cost of one whole unit, assuming a life of 30 years and an economic opportunity cost of 12%, would be about US $ 120,000 (1.33 million Som).

However it could be argued that, if Kyrghizstan Railways does not have independent facilities for carrying out all types of major overhauls, it would need to acquire additional locomotives as a kind of insurance, so that traffic can continue to be carried even when there is a disruption to maintenance services provided by foreign workshops. In a worst case scenario, associated perhaps with general economic disruption in the region, the loss of workshop services could conceivably last one year or so.

Assuming that, under such extreme circumstances, the traffic carried was to fall by 50%, about four main line locos and four shunting locos could be incapacitated through lack of KR1 and TR3 maintenance (based on an annual requirement estimated in Section 3.8 of three KR1 per loco and 4-5 TR3 per loco each year). To keep 12 main line locos in operation, in addition to the three spare locomotives assumed in Section 3.7, an additional locomotive would be required in the fleet. An additional shunting loco would also be required. There are considerably numbers of underutilised locomotives in Kyrghyzstan so the cost of the additional locomotives is essentially the additional maintenance costs. As described earlier the annual economic cost of maintaining a main line loco is US$ 77,000. The equivalent figure for a shunting loco would be no more than

half this, giving a total annual cost for reserve locos of US$ 110,000 (Som 1.2 million). In practice the cost would probably be less (because the locomotives would not be intensively utilised).

Reduction in Administrative Costs

The potential administrative cost savings appear to be rather small. The number of loco visits to external workshops is expected to be about 18 in both 1998 and 2008. Even assuming one senior staff has to be employed solely to handle all the contractual work, including follow up, the annual costs would be about 67,000 Som as roughly estimated below.

Item	Annual Cost (Som)
Basic Salary (Assuming between 1995 and 2008 that average salaries are 50% higher than present levels of 1,500 Som)	27,000
Other Employment Costs (70% of basic salary)	19,000
Equipment and Office Overhead Costs (70% of staff costs)	19,000
Travel Expenses to Inspect Work Undertaken (120 Som per visit/26 visits per year)	2,400
TOTAL ADMINISTRATIVE COST	67,400

Other Benefits

The other potential benefits of increased efficiency due to additional competition offered by the Bishkek workshops appear to be negligible. The workshop is not situated in a favourable position for use by other railways and so would not be used by them. Once the Bishkek workshop was improved, it is possible that charges made to Kyrghyzstan Railways for heavy repairs at other workshops would be reduced. However it may have little effect on maintenance costs generally in the region. Therefore competition benefits are assumed to be zero.

There also appears to be only limited scope for reducing equipment acquisition or facility development costs at other workshops in the region following the improvement of the Bishkek workshop. There is substantial excess capacity at other workshops and little need for replacement of major maintenance assets. However it is possible that less equipment maintenance costs would be incurred: perhaps as much as half the equipment maintenance cost estimated for the additional equipment required for the modified Bishkek workshop, that is a potential benefit of 250,000 Som per year.

Comparison of Costs and Benefits

The annual benefits (in million of Som) of improving the Bishkek workshop are summarised in the table below.

	Base Scenario	
	1998	2008
ANNUAL BENEFITS		
Transport Costs	0.70	0.70
Reserve Loco Costs	0.00	0.33 - 1.20
Administration Costs	0.07	0.07
Equipment Maintenance Costs	0.25	0.25
Total Annual Benefits	1.02	1.35 - 2.22
ANNUAL COSTS		
Workshop Overheads	0.79	0.94
Total Annual Costs	0.79	0.94
NET ANNUAL BENEFITS	0.23	0.41 - 1.28

Annual benefits amount to about 1.02 in 1998, increasing to between 1.35 and 2.22 in 2008 (depending on assumed reserve loco benefits). After subtracting workshop overhead costs, this gives an annual net benefit of 0.23 million Som in 1998 and 0.41 - 1.28 million Som in 2008 (depending on reserve locomotive benefits).

For the modified workshop option costing 15.8 million Som, this represents an annual return in 1998 of 1.5%, increasing to 2.6 - 8.1% in 2008.

For the newly constructed workshop costing 32.7 million Som the annual return in 1998 would be 0.7% in 1998 and 1.3 - 3.9% in 2008.

The result is not sensitive to alternative assumptions of traffic. Even with the higher freight traffic forecasts, the return would be very similar because most locomotives are used on passenger services and the numbers of KR1 and TR3 would only increase by about 5% (for about one extra locomotive). Benefits would increase by a correspondingly small amount.

The result is more sensitive to alternative assumptions about reserve locomotive requirements. According to the above assumptions the workshop may only reduce the fleet requirement by 0.3 locomotive unit, which represents less than 1% reduction. However if the risk of disruption to maintenance services requires the railway to increase the fleet as suggested earlier, then the reduction in fleet requirement attributable to the workshop would be one main line loco and one shunting loco.

It should be noted that modifications to maintenance and utilisation of locomotives could achieve at least part of these benefits with much less investment. In particular it is assumed in the analysis that double locomotive units continue to haul passenger trains even though single units would be sufficient over most of the network. The potential saving in locomotive acquisition costs (let alone running costs) from using single units would be far greater than the potential savings attributable to the workshop modification.

On the other hand the result would be very sensitive to the assumed workshop construction costs (which appear to be rather low). If actual construction costs in Kyrghyzstan were 2-3 times those assumed in the evaluation then the return would probably be less than 1%.

On the basis of these arguments it can be concluded that the economic return from investment in a new workshop is low, between 1.3 and 3.9% which is far below the minimum acceptable economic return (between about 8 and 15%) which is normally considered to be acceptable for financing by governments and international development agencies. The cheaper modified workshop alternative achieves a higher return of between 2.6 and 8.1% in the long term, but even this is rather low.

This result reflects the current situation in the TRACECA Region that because of the present surplus workshop capacity and locomotives, expanding the Bishkek workshop simply increases overall maintenance costs for the Region as a whole. For this reason, improving the existing workshop gives a more attractive economic return than building a new workshop. If there is a significant risk of disruption to supply of

maintenance services, then it is likely that operating additional spare locomotives would be cheaper, in economic terms, than increasing workshop capacity.

Financial Analysis

From the financial point of view of the Kyrghyzstan Railway, which does not suffer the consequences of the reduction in utilisation of existing maintenance facilities in other countries that would be caused by the improved Bishkek workshop, the project may seem more attractive.

For example the short term variable financial cost (excluding capital costs of buildings and equipment, and workshop overheads) of the maintenance programmes carried out in Bishkek workshop could be reduced below current charges of other workshops (including transport costs) as shown in the following table (all figures in thousands of Som at 1996 values). This could allow a financial saving to the railway of between 2.0 and 4.4 million Som in 1998, depending on taxation arrangements. Offsetting this would be additional annual workshop overheads which are estimated as 0.8 million Som. The net annual saving to the railway is therefore between 1.2 and 3.6 million Som. These figures should be interpreted with caution - the contract prices for shunting locomotives are lower than expected on the basis of the assumed internal maintenance costs suggesting that they are not based closely on costs and therefore may be subject to change in the future.

For the modified workshop option, the above savings would represent an annual financial return on the investment (of 15.8 million Som) of 7-23% in 1998. The equivalent figures for the new workshop option would be only 4-11%. The results are rather sensitive to assumptions about the contract rates charged by external workshops (which include substantial profit margins of 100% or so, and could reduce if there is more competition between workshops in future years) and whether or not the VAT charged on the maintenance can be passed on by the railway to its customers (under reciprocal arrangements between Kyrghyzstan and neighbouring countries).

The financial return for the modified workshop is reasonably high, suggesting that this project could be funded from maintenance cost savings. However because of the uncertainty about future contract rates and the capital cost of the project, it is by no means clear that the railway would benefit financially from carrying out the KR1 and TR3 in the modified workshop. It could possibly lose money from carrying out this work in Bishkek if the actual construction cost was more than anticipated or if lower contract prices could be secured.

Locomotive /Maintenance Type	Cost of External Maintenance per Unit (Som thousand)			Variable Cost of Internal Maintenance (Som thousand)			Difference in Cost (excl tax) (Som thousand)	Annual Units Overhauled	Cost Saving per Year (Som thousand)
	Workshop Charge (excl VAT)	Transport	Total	Labour (including bonuses and benefits)	Materials	Total			
Mainline KR1	1,241	28	1,269	111	692	803	466	5	2,330
	(1,061)		(1,089)				(286)		(1,430)
Mainline TR3	435	2	437	39	242	281	156	10	1,560
	(372)		(374)				(93)		(930)
Shunting KR1	730	28	758	94	692	786	-28	2	-56
	(624)		(652)				(-134)		(-268)
Shunting TR3	130	2	132	18	242	260	-128	4	-512
	(111)		(113)				(-147)		(-588)
TOTAL									3,322
									(1,504)

NOTE (1) Assuming 30% additional savings due to unplanned repairs, and additional saving in administration costs of 67,400 Som which would also be expected, the total annual saving equal to 4,386 thousand Som (2,023 thousand Som excluding tax).

(2) The internal maintenance costs exclude workshop overheads (estimated earlier as 788 thousand Som per year).

(3)

Source: Cost estimates for main line locomotives (for external and internal maintenance) are those given in the main study. Shunting locomotive maintenance costs are roughly estimated proportionately from labour hours expected by Kyrghyzstan Railways for main line and shunting locomotives (see Section 3.8).

Annex 9

Evaluation of Modification of Wheel Workshop

Background

Kyrghystan railways consists of two independent sections. The main section of 322.7 km is centred on Bishkek in the north was part of the railways of southern Kazakstan; the other section is 101.2 km of branch-lines, centred on Jalalabad, which were part of the Uzbekistan railways. The two sections are not connected physically within Kyrghystan and the shortest distance by rail between Bishkek and Jalalabad is 1283 km.

The railway is developing a wagon repair workshop at Belavodskoe using a disused building. Reconstruction work on the building is required plus the provision of rail access tracks. This evaluation considers the additional costs and benefits of developing a workshop within the wagon repair work which would be used for assembling and disassembling of wheels (mainly for wagons and coaches). At present this activity has to be performed outside Kyrghystan so that when new wheels are purchased, the old wheels and axles have to be sent to a foreign workshop, and the new wheels returned after fitting to the axles.

General Approach

This evaluation is carried out in economic terms in which costs and benefits for the TRACECA Region as a whole are estimated, in terms of actual resources consumed rather than in terms of what particular railways pay. Therefore, where possible, adjustments are made to recorded financial costs paid by the railways to remove transfer payments such as taxes and subsidies.

To achieve efficient use of capital, the Kyrghystan Government, would favour projects which can give high economic returns. Like other governments and international development agencies, projects which offer low economic returns would be expected to be given lower priority. It is not uncommon for minimum economic rates of return to be required before international finance is used for projects. Depending on the economic circumstances of the country, this minimum return commonly varies between 8 and 15%.

The financial implications for Kyrghystan Railways of the project are also estimated at the end of the evaluation to assess if the project would increase profitability or not. For this financial evaluation, no adjustments are required to recorded costs.

The evaluation has involved making numerous assumptions, many of which could not be accurately verified. For this reason the results should be interpreted with care. Sensitivity analyses are performed to assess the likely effect of the major uncertainties.

Options

The following options have been compared in the evaluation:

a) Continue as Present - sending wheels sets from Kyrghystan to other workshops for disassembly/reassembly of wheel sets for wagons, coaches and locomotives,

b) Expand, with wheel set disassembly/assembly equipment, the new wagon repair shop, Belavodskoe, currently under construction, to carry out all planned wagon and coach wheel replacement in Kyrghystan (and, when needed, repair locomotive wheel sets)

Main Assumptions

The following assumptions have been made in the evaluation.

Traffic Scenarios

To evaluate workshop improvements, a long term evaluation period must be considered, comparable to the lifetime of the assets involved (typically 20 years for workshop equipment and even longer for buildings). To assess the long term impact of the proposed improvements, annual benefits are estimated for two years: the first year in which the improvements are made (1998 assuming immediate implementation) and the middle of the expected life of workshop assets (2008, assuming a life of 20 years).

The base traffic scenario assumed in the evaluation is that used in the main study, which is referred to here as the medium growth scenario:

- **medium** growth in freight traffic (constant up to 2000 and then at about 2% per year, in proportion to 1995:1.0, 1998:1.00 and 2008:1.16) and passenger traffic remaining constant.

In addition a higher growth scenario is considered when assessing the sensitivity of the evaluation results to traffic level:

- **high** growth in freight traffic (a recovery in the short term followed by faster long term growth, in proportion to 1995:1.0, 1998:1.25 and 2008:1.75) and passenger traffic remaining constant (based on views of the railway),

Railway Development

In addition the following assumptions have been made about railway development:

- productivity improvements in maintenance both in Kyrghystan and abroad (leading to staff reductions but increased salaries),
- continuation of same type of rolling stock for about ten years and then gradual replacement with modern technology,
- no major change in motive power type (e.g. introduction of diesel multiple units),
- improvements in equipment utilisation above historic levels as the surplus equipment is reduced and efficiency improvements are made,
- rolling stock in south of country to be maintained in Uzbekistan to avoid excessive transport costs of rolling stock to/from Bishkek,
- economic maintenance costs (excluding fixed costs for buildings and equipment) are the same in all workshops in the region.

Other

Exchange rate in mid 1995 of USD 1 = 11 Som (which remained fairly unchanged during 1996).

Definition of Project Costs

The following capital and running costs have been considered in the evaluation:

- capital cost of additional building rehabilitation work needed to provide facilities for wheel set maintenance (not including the cost of work required to establish the wagon repair shop),
- capital cost of additional equipment specifically required for the wheel set maintenance work,
- additional annual overheads for building and equipment maintenance cost, heating and lighting, and headquarters costs.

Definition of Project Benefits

The following potential benefits have been considered in the evaluation:

- reduction in transport costs of wagon and carriage wheel sets to other workshops
- reduction in transport costs of loco wheel sets, where wheels sets have to be repaired (not during planned maintenance at external workshops),
- possibly a reduction in wheel set inventory costs due to reduced time spent in transport or due to security requirements,
- reduction in administrative costs involved in handling contracts for wheel set maintenance at external workshops,
- possible reduction in maintenance costs from increased competition in maintenance services in the region (perhaps at depots outside Kyrghystan which are nearer to Bishkek than to any other workshop (such as Jambul) offering wheel set maintenance, if maintenance costs at Bishkek are competitive with other workshops),
- reduced acquisition and maintenance cost of maintenance equipment at workshops outside Kyrghystan because of the reduction in maintenance work on Kyrghystan wheel sets.

Estimation of Costs (mid 1995 prices)

The main project cost is the acquisition of the equipment - 20 million Som as described in Section 4.7. An additional 10% is estimated to be required for fitting services and for making building modifications (representing about 30% of the new value of the building, which is assumed to be about 0.6 million Som for 220 m^2 of floor space in accordance with reported building costs in Kyrghystan). This gives a total amount of 22 million Som.

The annual overhead cost of the workshop is estimated at 1.03 million Som. The main proportion of this is attributable to the equipment maintenance cost (5% of the equipment value, equal to 1.0 million Som). Building maintenance and heating/lighting are each assumed to be 2% of the value of the building (24 thousand Som total cost), while other overheads are assumed to be 10% of direct labour costs (estimated as 5,500 person hours for 2-3 people employed for eight hours per day as described in Section 4.8, at current Kyrghystan rates of 12.5 Som per hour, including social insurance, benefits and bonuses, giving overheads of 7 thousand Som). Although salary costs are expected to increase in the long term this makes an insignificant difference to overhead costs.

Estimation of Benefits (mid 1995 prices)

Project benefits have been approximately estimated on the following basis.

Transport Cost Benefits

The distance from Bishkek to Jambul (the external workshop which is principally considered for this work) is 270 km. Other workshops which could offer wheel set assembly services are further than this - Tashkent (683 km) and Almaty (580 km). The average round trip distance from Bishkek to external workshops is assumed to be 600 km

Transport costs to other workshops is assumed to be 0.58 Som per km for each wheel set. The rate per unit is based on a nominal economic cost (excluding taxes) of medium distance rail transport of 11 Som per wagon load km (0.2 Som per tonne km for 55 tonnes load, applicable when there is no empty running involved) and 19 wheel sets per wagon (19 wheel sets without gears can be loaded and the average figure should be similar to this because loco wheel sets should constitute less than 5% of the total).

If the wheel assembly workshop is implemented then an additional transport cost would be involved

transporting carriage wheels from the Bishkek carriage works to the new wagon works - a round trip distance of 80 km. Assuming this was done by road at an economic cost of 11 Som per truck km, loading 8 wheel sets per truck (more than at present using a small truck) this implies a cost of 110 Som per wheel set. No such cost would be incurred for wagon wheel sets because the wagons would be overhauled adjacent to the wheel shop. Loco wheels would incur a slightly higher transport cost than for carriages because less wheel sets could be loaded on the truck - however few loco wheels would be transported and, as an approximation, they are assumed to have a similar cost to carriage wheels.

The number of wheel sets requiring disassembly/reassembly is estimated in Section 4.5 to be 938 per year, based on current rates of wheel turning and expected life of wheels. Based on an active fleet of about 1,500 wagons and 350 coaches , with a relative utilisation (in km) of 1:10, this implies an approximate ratio of two coach wheel sets for every wagon wheel set. Assuming 2% of wheel sets turned are for locomotives, this gives about 19 locomotive wheel sets, 306 wagon wheel sets and 613 coach wheel sets. Assuming that conditions remain unchanged, the number of wheel sets requiring disassembly/reassembly would increase with freight traffic by 2008, from 938 to 988, due to 16% increased distance operated by wagons, under the base traffic scenario (or up to 1,168 under the high growth scenario in which freight increases by 75%).

The annual economic benefits in 1998 and 2008 from savings in transport costs for the base scenario are summarised in the following table.

	Wagons		Coaches		Loco Units	
	1998	2008	1998	2008	1998	2008
Annual Wheel Sets Repaired	306	356	613	613	19	19
Transport Cost to External Workshop per Wheel Set (Som)	348	348	348	348	348	348
Transport Cost to New Workshop per Wheel Set (Som)	0	0	110	110	110	110
Net Benefit per Wheel Set (Som)	348	348	238	238	238	238
Annual Benefit (Som thousands)	106	124	146	146	5	5

According to these assumptions the total annual benefit from reduced transport of wheel sets would be 257 thousand Som in 1998 and 275 thousand Som in 2008.

Saving in Inventory Cost

Savings could potentially accrue from (a) reduction in time spent by wheels travelling from Kyrghystan to/from external workshops, and (b) reduction in a security reserve which the railway may wish to establish in order to guarantee supply of wheels even if maintenance services are disrupted.

The average additional number of days spent by a wheel set travelling to and from the external workshops (compared to that which would be spent to/from the proposed new workshop) is assumed to be four days for the round trip. The number of spare wheel sets that are needed to cover for the time spent on these visits is therefore ten in 1998 and 11 in 2008 (number of annual wheel sets repaired*4/365). Assuming an average value (over the life of the wheel) of 20,000 Som per wheel set (based on the reported cost of new wheels and axles of USD 1,210 and USD 1,290 respectively) and an economic opportunity cost of capital of 12% this represents a potential annual benefit of 26,400 Som in 2008 under the base scenario. However it could take several years to realise this benefit because of the current surplus stock of wheel sets.

The railway currently has no security reserve. However it has a considerable excess of wheels on underutilised rolling stock. It could be argued that Kyrgyzstan Railways needs to establish in the long term a stock of assembled wheel sets in order to safeguard itself against disturbances in neighbouring countries. If, for example, the railway wished to insure itself against the unlikely event in which all the railways in the region became unable to carry out assembling/disassembling work for a period of 9-12 months, it would need to keep in store up to 700-1,000 wheel sets. In practice, under such extreme circumstances, traffic on the

railway would probably fall considerably and so a strategic reserve of only 500 wheel sets would be adequate.

Keeping such a security reserve would incur inventory costs in 2008 of 1.2 million Som assuming a cost per wheel set of 20,000 Som and an opportunity cost of capital of 12%.

Reduction in Administrative Costs

The potential administrative cost savings seem to be small. In 1998 up to four wheel sets (seven in 2008) are envisaged to be sent daily for assembly/disassembly, implying about 20-40 under repair or in the course of transport at any one time. Even assuming one senior staff has to be employed solely to handle all the contractual work, including follow up, the annual cost is likely to be less than 100,000 Som as roughly estimated below.

Item	Annual Cost (Som)
Basic Salary (Assuming between 1995 and 2008 that average salaries are 50% higher than present levels of 1,500 Som)	27,000
Other Employment Costs (70% of basic salary)	19,000
Equipment and Office Overhead Costs (70% of staff costs)	19,000
Travel Expenses to Inspect Work Undertaken (120 Som per visit/26 visits per year)	2,400
TOTAL ADMINISTRATIVE COST	67,400

Reduced Maintenance Equipment Costs at Other Workshops

There appears to be some scope for reducing equipment acquisition and maintenance costs at other workshops in the region following the improvement of the Belavodskoe workshop. Although there is substantial excess capacity at other workshops and currently little need for replacement of major maintenance assets, there could be a reduction in equipment maintenance costs of about 1.0 million Som per year (the amount estimated for maintenance of the new equipment in Belavodskoe).

In addition there could eventually be a reduction in acquisition of new equipment at the other workshops: but since the equipment in Belavodskoe will be rather poorly utilised (at less than 50% of capacity) the scope for the reduction will be less than half of the value of the Belavodskoe equipment (20 million Som). Therefore it is assumed that these benefits are only about 0.5 million Som per year averaged over the next 20 years or so.

This gives total reduced equipment provision costs in other workshops of 1.5 million Som per year.

Other Benefits

The other potential benefits of increased efficiency due to additional competition offered by the Belavodskoe workshop appear to be negligible. The workshop is not situated in a favourable position for use by other railways and so would not be used by them. For example the nearest depot of Kazakstan Railways at Andijan is nearer to Jambul than to Bishkek and there seems little reason to expect wheel sets to be repaired at Bishkek. Once the new wheel set workshop is completed, it is possible that charges made to Kyrghystan Railways for wheel assembly/disassembly at other workshops would be reduced. However it would have little effect on maintenance costs generally in the region. Therefore competition benefits are assumed to be zero.

Conclusion

As shown in the table below, the annual benefits (in thousand of Som) of implementing the Belavodskoe workshop amount to about 1,824 in 1998, increasing to between 1,868 and 3,042 in 2008. After subtracting workshop overhead costs, this gives an annual benefit of 0.8 million Som in both 1998 and between 0.8 and 2.0 million Som in 2008. This implies an annual return on the 22 million Som investment of about 3.6% in 1998, rising to between 3.6 and 9.1% in 2008.

	Base Scenario		High Growth Scenario	
	1998	2008	1998	2008
ANNUAL BENEFITS				
Transport Costs	257	275	284	338
Inventory Costs	0	26-1,200	0	31-1,440
Administration Costs	67	67	67	67
Equipment Provision	1,500	1,500	1,500	1,500
Total Benefits	1,824	1,868-3,042	1,851	1,936-3,345
ANNUAL COSTS				
Workshop Overheads	1,030	1,030	1,030	1,030
Total Annual Costs	1,030	1,030	1,030	1,030
NET BENEFITS	794	838-2,012	821	906-2,315

Since this estimated return is rather low compared to the normal minimum acceptable economic return (of between 8 and 15%) the project may not be considered viable in economic terms. This result is not particularly sensitive to traffic level because most of the wheel sets to be assembled/reassembled would be for passenger coaches rather than freight wagons and there is little prospect of an increase in passenger traffic. Increasing freight traffic by 75% by 2008 increases the project benefits to between 906 and 2,315 thousand Som, but the annual return remains at between 4.1 and 10.5%.

Clearly the result is sensitive to whether or not the railway would establish a security reserve of 500 wheel sets (over and above the normal inventory) as assumed in the evaluation. The extent to which the railway chooses to increase the inventory is likely to depend on circumstances which vary from year to year and it is not possible to anticipate the railway's long term policy in this regard.

The result is also sensitive to the degree to which cost savings can be achieved through rationalisation of equipment and other fixed costs in other workshops which currently perform the wheel assembly/disassembly work for Kyrghystan Railways. Under the present situation, with considerable excess workshop capacity throughout the TRACECA Region, there must be some doubt about whether these benefits could be achieved in practice. Therefore the economic return is most unlikely to be more than the figures estimated above.

The economic viability of the proposed wheelshop project depends on factors such as future traffic level, future inventory levels and extent to which equipment can be redeployed from one workshop to another within the TRACECA Region. It is possible that if traffic levels grow more than assumed in the moderate traffic scenario and the railway intends to establish a significant security reserve of wheel sets, then the proposed workshop can be justified economically if the equipment can be acquired second-hand from other railways (thus minimising the duplication of equipment on TRACECA railways).

However from the financial point of view of the Kyrghystan Railway, which does not suffer the consequences of the reduction in utilisation of existing maintenance facilities in other countries that would be caused by the new Belavodskoe workshop, the project may seem more attractive.

For example the variable financial cost (excluding depreciation of buildings and equipment) of the wheel set disassembly/assembly work carried out in the Belavodskoe workshop could be reduced below current charges of other workshops as shown in the following table. This could allow a financial saving to the railway (net of transport charges and administration costs) of between 6.0 and 11.2 million Som (depending on tax liabilities) per year at present. This corresponds to an annual saving of between 5.0 and 10.2 million Som after allowing for overhead costs of the proposed workshop, representing an attractive financial return of 23-46% on the 22 million Som investment. This high level of return suggests that the Kyrghystan Railways could finance the capital expenditure required for the project quite comfortably from the maintenance cost savings.

However current charges for wheel disassembly/assembly appear to be excessively high, possibly because of the use of standard pricing formulae which impose uniform levels of overheads irrespective of actual costs

incurred. In this case the result appears to be overheads of about 20-30% of labour and materials which are far greater than those attributable to the activity being carried out (about 4% according to our estimate for the proposed wagon workshop). It is possible that, once contract prices are more closely related to actual costs, the financial advantages to the Kyrghystan Railways would be much less than estimated above.

In view of the potential for reducing contract prices, it is recommended that Kyrgyzstan Railways try to negotiate better terms for the wheel disassembly/assembly work and, if necessary, reassess the potential financial savings.Comparison of Contract Prices and Internal Costs of Assembling/Disassembling Wheel Sets (1996 Prices)

Cost of External Maintenance per Wheel Set (Som)			Variable Cost of Internal Maintenance (Som)				Difference in Cost per Wheel Set (excl. tax) (Som)	Annual Wheels Sets in 1997	Cost Saving per Year (Som thousand)
Workshop Charge (excl. VAT)	Transport (incl. tax)	Total (excl. VAT)	Labour (including bonuses and benefits)	Materials	Road Transport	Total			
37,980 (32,462)	601	38,581 (33,063)	37	26,600	70	26,707	11,874 (6,356)	938	11,138 (5,962)

NOTE (1) The contract price is for fitting two new wheels on a second-hand exchange axle. Assuming additional saving in administration costs of 81,000 Som (at 1996 prices), the total annual saving would be equal to 11,219 thousand Som (6,043 thousand Som excluding tax).
(2) The internal maintenance costs assume two wheels are fitted costing USD 1,210 each delivered to Bishkek, using 2.5 hours of labour @ 12.5 Som/hour at 1995 prices (which was the current Kyrghystan labour rate, including social insurance, bonuses and benefits), and exclude workshop overheads (estimated as 1,030 thousand Som per year at 1996 prices).

SOURCE: Quotes for contract work in Kazakhstan workshops and Consultants' estimates of Kyrghystan maintenance costs (adjusted from 1995 prices assuming 20% inflation).

TACIS/TRACECA	LIST OF SPAREPARTS NEEDED IN CONTEXT WITH EXECUTIONS OF PLANNED INSPECTION OF ROLLING STOCK; KYRGHYSTAN								
TYPE OF ROLLING STOCK:	**MAIN LOCO (2 TM 10)**							**ANNEX 4**	
SPAREPART NAME:	**PRICE/UNIT $**	**TYPE OF INSPECTION**							
		TR1		**TR2**		**TR3**		**KR1**	
		quantity	**price total $**	**quantity**	**price total $**	**quantity**	**price total $**	**quantity**	**price total $**
Adapter of indicate crane	8,75			1	8,75	2	17,50	8	70,00
Adapter of injector	6,43			1	6,43	3	19,29	12	77,16
Cylinder shell	511,38			3	1534,14	6	3068,28	10	5113,80
Main plain bearing	44,64			10	446,40	22	982,08	22	982,08
Main plain bearing	41,71			3	125,13	6	250,26	12	500,52
Main plain bearing	42,86			3	128,58	6	257,16	12	514,32
Connecting rod ring oil survey	73,75	2	147,50	20	1475,00	20	1475,00	20	1475,00
Connecting rod ring oil condense	141,07	7	987,49	20	2821,40	40	5642,80	40	5642,80
Connecting rod	45,71	10	457,10	40	1828,40	80	3656,80	80	3656,80
Piston upper	92,14			4	368,56	8	737,12	10	921,40
Piston lower	92,14			3	276,42	6	552,84	10	921,40
Piston pin	33,57			1	33,57	3	100,71	12	402,84
?	3,75	1	3,75	9	33,75	20	75,00	20	75,00
Atomizer	41,19	1	41,19	6	247,14	15	617,85	20	823,80
Injector	144,73					1	144,73	6	868,38
Poain bearing of connecting rod	31,20	1	31,20	11	343,20	28	873,60	40	1248,00
Plain bearing of upper head connecting rod	15,89			1	15,89	3	47,67	20	317,80
Pump component	26,63			5	133,15	10	266,3	20	532,60
Oil filter	0,16	28	4,48	28	4,48	28	4,48	28	4,48
Fuel filter	0,11	6	0,66	8	0,88	8	0,88	8	0,88,
Coupling disk	0,14	2	0,28	25	3,50	25	3,50	25	3,50
Rotor blade	34,67			8	277,36	15	520,05	72	2496,24
Water pump shaft	80,36					1	80,36	1	80,36
Plain bearing of motor axle	336,25			4	1345	9	3026,25	12	4035,00
Section unit joined	312,33					1	312,33	4	1249,32
Section unit joined	387,71			1	387,71	2	775,42	8	3101,68
Box Lube and board acceleration	43,04			1	43,04	3	129,12	12	516,48
Electro brush of electro motor	1,85	5	9,25	72	133,20	72	133,20	72	133,20
Electro-brush A-705	0,42	2	0,84	10	4,20	24	10,08	24	10,08
Electro-brush A-76	0,74			6	4,44	24	106,56	24	106,56
Electro- brush 311	0,49	8	3,92	180	88,20	180	88,20	180	88,20
TOTAL			**1.687,66$**		**12.117,92$**		**23.975,42$**		**35.969,68$**
									Total 73.750,68$

TACIS/TRACECA	LIST OF SPAREPART NEEDED IN CONTEXT WITH EXECUTIONS OF PLANNED INSPECTION OF ROLLING STOCK; KYRGHYSTAN

TYPE OF ROLLING STOCK: SHUNTING LOCO — **ANNEX 5**

SPAREPART NAME:	PRICE/UNIT $	TYPE OF INSPECTION: TR1		TR2		TR3		KR1	
		quantity	price total	quantity	price total	quantity	price total	quantity	price total
Shell of cylinder	321,40			1	321,40	2	642,80	6	1928,40
Plain bearing 1-6	80,38					2	160,80	5	401,90
Plain bearing 4	91,03					1	91,03	1	91,03
Plain bearing 7	169,90					1	169,90	1	169,90
Connecting rod	162,70					1	162,70	6	976,20
Plain bearing of connecting rod	84,10					2	168,20	12	1009,20
Pin	55,36							3	166,10
Ring condense	37,50	1	37,50	6	225,00	12	450,00	12	450,00
Ring oil servey	29,29	1	29,30	9	263,60	12	351,50	12	351,50
Ring trapez	32,32			6	193,90	12	387,80	12	387,80
Roof of cylinder	601,82					1	601,82	3	1805,46
Exhaust valve	79,46			1	79,46	3	238,38	12	953,50
Inlet valve	79,46			1	79,46	3	238,38	12	953,50
Water pump wing	44,60					1	44,60	1	44,60
Shaff of water pump	37,50							1	37,50
Atomizer	200,00					1	200,00	6	1200,00
Injector	41,07	3	123,20	6	246,4	6	246,40	6	246,40
Plug of upper head of connecting rod	8,40					1	8,40	6	50,40
Plain bearing of connecting rod	86,60			2	173,20	2	173,20	6	519,60
Bolt of connecting rod	3,20					1	3,20	6	19,20
Pump component	26,60					4	106,40	6	159,60
Filter of thin clean of oil	0,08	5	0,40	10	0,80	10	0,80	10	0,80
Filter of thin clean fule	0,11	2	0,22	2	0,22	2	0,22	2	0,22
Plain motor axle	326,90			1	326,90	2	653,80	6	1961,40
Exhaust valve directing	21,60					1	21,60	8	172,80
Inlet valve	18,20					1	18,20	7	127,40
Section of fuel pump	171,40					1	171,40	3	514,20
TOTAL			**190,60 $**		**1.910,34 $**		**5.311,53 $**		**14.698,61 $**
									TOTAL $ 22.111,08

TACIS/TRACECA	LIST OF SPAREPART NEEDED IN CONTEXT WITH EXECUTIONS OF PLANNED INSPECTION OF ROLLING STOCK; KYRGHYSTAN

TYPE OF ROLLING STOCK: FREIGHT WAGON

SPAREPART NAME:	PRICE/UNIT $	TYPE OF INSPECTION							
		TR1		TR2		TR3		KR1	
		quantity	price total	quantity	price total	quantity	price total	quantity	price total
Autocoupling in complex CA-3	294,70					1	294,70		
Lock	28,30					1	28,30		
Lockholder	4,30			1	4,30	2	8,60		
Safety lock front	5,00			1	5,00	2	10,00		
Gusset of draft collar	8,90			1	8,90	2	17,80		
Main brake valve (air distributor) 305	151,80			1	151,80	2	303,60		
Main brake valve (air distributor) 292	158,90			1	158,90	2	317,80		
Shell front brake	9,20			5	46,00	45	414,00		
Crane	24,60			1	24,60	2	49,20		
Wheel sets with boxes	2571			1	2571,00	2	5142,00		
Doors of closed vagons 6b16	19290					1	19290,00	1	19290,00
Roof of hutch way	705,40					2	1410,80	2	1410,80
Doors fo high sided vagons	10428,0			1	10428,00	2	20856,00	2	20856,00
Labyrint ring	8,30			2	16,60	4	33,20	6	49,80
?	12,10			2	24,20	4	48,40	6	72,60
Absorbing apparatus	203,80			1	203,80	1	203,80	2	407,60
Brake hose	20,10			4	80,40	4	80,40	4	80,40
Small shaft	214,30			2	428,60	4	857,20	8	1714,40
Shell metallceramic	75,00			2	150,00	6	450,00	15	1125,00
Shell of side frame	670,00					3	2010,00	8	5360,00
Brake shoe	5,00			4	20,00	8	40,00	8	40,00
Check of brake shoe	3,42			1	3,42	3	10,26	8	27,36
Gusset of draft collar	8,90			1	8,90	1	8,90	2	17,80
Wheel-sets of boxes	2375,00			1	2375,00	2	4750,00	4	9500,00
TOTAL					**$ 16.709,42**		**$ 56.634,96**		**$ 59.951,80**
									TOTAL $ 133.296,18

TACIS/TRACECA	LIST OF SPAREPART NEEDED IN CONTEXT WITH EXECUTIONS OF PLANNED INSPECTION OF ROLLING STOCK; KYRGHYSTAN

TYPE OF ROLLING STOCK: PASSENGER WAGON — **ANNEX 7**

SPAREPART NAME:	PRICE/UNIT $	TYPE OF INSPECTION: TR1		TR2		TR3		KR1	
		quantity	price total	quantity	price total	quantity	price total	quantity	price total
Bearing 36-42706 lum	80,00			2	160,00	4	320,00		
Bearing 36-232726 lum	80,00			2	160,00	4	320,00		
skpinton	264,00					4	1056,00		
Shell shpinton (running gear s.p.)	62,50			2	125,00	2	125,00		
Nut of skpinton (running gear s.p.)	36,80			1	36,80	2	73,60		
Spring of boogie (outward) 34.20.103	38,00			2	76,00	4	152,00		
Hanging inside 10.20.101	93,20			2	186,40	2	186,40		
Hanging single (soktary) identical	60,40			1	60,40	1	60,40		
Zwieback	2,68			1	2,68	2	5,36		
Hydraulic sloker of centre fluctuation	149,60			1	149,60	2	299,20		
Director of slaker of vibration	8,87			1	8,87	2	17,74		
Ring condense	8,00			1	8,00	4	32,00		
Amortisation under spring	3,20			1	3,20	2	6,40		
Selfmoving component of amortisation	1,50			1	1,50	8	12,00		
Pulley running	58,80					1	58,80		
Leading pulley	96,40					1	96,40		
Junction of running pulley	525,50					1	525,50		
shaft	28,60					1	28,60		
Spring of central hanging outside	72,50			1	72,50	2	145,00		
Spring of middle hanging	43,80			2	87,60	4	175,20		
Spring of inside hanging	19,70			1	19,70	2	39,40		
Horizontal sliping (gliding)	58,10			1	58,10	2	116,20		
Wagon sliping	257,60					2	515,20		
Cheque of brake shoe	3,42			2	6,84	4	13,68		
Brake cast iron shoe	6,00			8	48,00	16	96,00		
Absorbed apparatus	203,80					1	203,80		
Axles of transmission	53,60			10	536,00	50	2680,00		
Spring of folding platforms	11,90			1	11,90	4	47,60		
Spring of folding platforms	13,40			1	13,40	4	53,60		
Parcel of rein in complex 11793-H	16,20			2	32,40	4	64,80		
Draft collar (hoose)	10,70			1	10,70	2	21,45		
Centralised beam	25,00			1	25,00	2	50,00		
Autocoupling in complex CA-3	294,70					1	294,70		
Lock	28,30					1	28,30		
Lockholder	4,30			1	4,30	2	8,60		

Safety lock front	5.00			1	5,00	2	10,00			
Gusset of draft collar	8,90			1	8,90	2	17,80			
Main brake valve (air distributor) 305	151,80			1	151,80	2	303,60			
Main brake valve (air distributor) 292	158,90			1	158,90	2	317,80			
Shell front brake	9,20			5	46,00	45	414,00			
Crane	24,60			1	24,60	2	49,20			
Wheel-sets with boxes	2571,00			1	2571,00	2	5142,00			
TOTAL					**$ 4.871,09**		**$14.183,28**			
										TOTAL $ 19.054,37