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Review of Railways Rehabilitation in Central Asia

for Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan

Feasibility Study of measures for the rehabilitation and renewal of the freight wagon fleet of Tajik Railways – DRAFT

September 2005

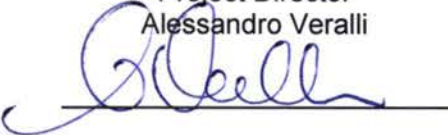


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EXECUTIVE SUMMARY

Railway transportation plays a great role in the Tajik economy, as it carries more than 90% of total external freight forwarding.

In 2004 rail freight imports and exports amounted respectively to 2,0 and 0,6 million net tons.

Between 1999 and 2004, rail import and export traffic experienced an average yearly growth rate of respectively + 4,9% and + 8.4%.

Export traffic is highly concentrated on two commodities, aluminium and cotton, which accounted for more than 70% of the total. Import traffic was mainly made by alumina and petroleum products.

The nature of transported goods and the very long average haulage distances make presently rail as the most cost effective mode of transport, especially in the light of the very poor state of road infrastructure and services.

Out of the total road network in Tajikistan, only 20% is estimated to be in fair condition, against 48% in poor condition and 32% in very poor conditions. The road maintenance backlog of the 4700 km of national roads is so serious that an annual requirement of 16 million USD has been calculated, which is almost twice the total road subsector budget.

Even if significant investments (mainly funded by IFIs) are being allocated to road transport and the involvement of the private sector is encouraged, truckers are likely to increase their relative competitive position only in the long term, in particular for lower volume, shorter-haul higher value goods where delivery speed is a greater requirement.

As a result, the potential for Tajik Railways to retain present freight volumes and categories seems high, provided that railways will put into action all the necessary measures to maintain future customer loyalty.

One of the most critical issues in rail freight transportation is represented by the poor condition of the wagon fleet, which suffers from:

- the lack of appropriate vehicles suited to particular commodities
- the lack of adequate maintenance.

On the side of the wagon fleet, in 2005, according to official data provided by Tajik Railways, 1756 vehicles are inventoried and 1405 result to be available for operation. However, only 800-900 represent the core fleet effectively used since a number of potentially available wagons are not serviceable because not suitable to meet traffic demand.

In particular, export traffic calls largely for covered and open wagons, which constitute only 45% of the total fleet. Moreover, these vehicles have an age profile rather imbalanced towards older units (25% of them have exceeded their useful life).

As a result, Tajik Railways, in order to provide an adequate service to freight customers, are obliged to resort to wagons hired from neighbouring countries.

On the maintenance side, two workshops are operating wagon preventive and corrective maintenance:

- one located in Dushanbe, where running and depot maintenance of wagons operating in the southern section of the rail network are performed
- the other located in Makhram, in the north of the country, where running, depot and light capital maintenance are carried out.

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A new workshop (located in Kurgan-Tyube, in the southern area) potentially dealing with wagon maintenance is under construction.

Only minimal wagon major overhaul is performed, due to shortage of spare parts and inadequate workshop equipment.

The inability to perform the required heavy capital maintenance leads to a low wagon availability rate and to the impossibility of potentially refurbishing certain rolling stock to prolong their useful life and/or carrying out appropriate conversion works to meet demand requirements.

The natural consequence is that Tajik railways are obliged to rely on other CIS countries for the provision of suitable wagons and for the carrying out of most major overhaul of wagons. This practice results to be time consuming and places a great burden on public finances also because it is paid in hard currency.

Without a coherent strategy to establish an efficient and reliable freight wagon fleet there is risk that rail will not be able to handle its share of freight transportation in the future.

Two possible alternatives have been identified and properly evaluated under the technical, financial and economic point of view over a twenty-year time horizon.

Alternative A would involve appropriate actions concerning:

- refurbishment and conversion of part of the existing wagon fleet
- minimal introduction of new rolling stock.
- rationalisation and improvement of maintenance infrastructure, equipment and operations.

The aim would be allowing to maximise the use of existing Tajik Railway's assets, increasing as much as possible operating efficiency and reducing capital maintenance costs.

Alternative B would imply:

- an accelerated programme of disposal of unserviceable and life-expired wagons which would be replaced by the purchase of new wagons.
- substantial improvement of maintenance equipment and operations.

This strategy would result in the complete short-term replacement of the current wagon fleet with a new fleet adequate to demand requirements and the development of facilities to meet the maintenance needs of the new fleet.

The two alternatives has been compared under the financial and economic point of view..

The results of the financial and economic appraisal indicate that the strategy of wagon fleet rationalisation based on a refurbishment programme of existing vehicles through the use of duly upgraded existing maintenance facilities (Alternative A) deserves higher priority over the strategy which involves substantial purchase in new vehicles (Alternative B).

Alternative A, in particular, results to be the least cost option in present value terms, allowing for an investment disbursement schedule more balanced along the time and avoiding hardly affordable outflows in the short-medium term. In addition, Scenario A permits to maximise the use of existing maintenance facilities, allowing for a more cost-effective use of the resources.

The long term capital cost requirement (to be spread over a 20 year's period) of Scenario A totals 107 Million USD.

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Even if such large amount could achieve a worthwhile investment, it seems unlikely that Tajikistan could easily cope with it over the next years.

The Consultant believes that, in order to ensure feasible funding opportunities towards international financing institutions, Project alternative A should be implemented through a staged approach.

The following phases would be suggested:

- Phase 1: implementation of short-medium term actions (2006-2015) aimed at tackling the wagon maintenance backlog and ensuring a better fleet composition through the maximisation of use of existing assets with some investment in new wagons, made necessary to compensate the technical impossibility of converting/life-extending the totality of wagons life expired or unable to meet future demand requests;
- Phase 2: carrying out of a long term action (2016-2025) focused on the realisation of a balanced wagon fleet (from the point of view of both fleet composition and age profile) and a modern and efficient maintenance organisation able to meet customer's expectations.

Phase 1 would consist in:

- refurbishing, through life-extension works, 228 wagons
- converting into covered and open wagons 452 wagons
- purchasing 346 new wagons
- rehabilitating existing maintenance facilities
- upgrading and specialising existing workshops, through:
 - the supply of new spare parts
 - the provision of modern equipment, suitable to perform operations of wagon life-extension, conversion and major overhaul.

The following investment costs may be estimated:

Table 1. - Phase 1 - Investment cost estimate (USD at 2005 prices)

	Foreign costs	Local costs	Total costs
Purchased of new wagons	24.250.027	0	24.250.027
Conversion of freight wagons	12.402.880	253.120	12.656.000
Refurbishment of freight wagons	4.679.892	95.508	4.775.400
Workshop rehabilitation	-	760.000	760.000
Purchase of workshop equipment	4.627.164	-	4.627.164
TOTAL	45.959.963	1.108.628	47.068.591

Phase 2 would envisage:

- refurbishing, through life-extension works, 336 wagons
- purchasing 853 new wagons

with the following total investment cost:

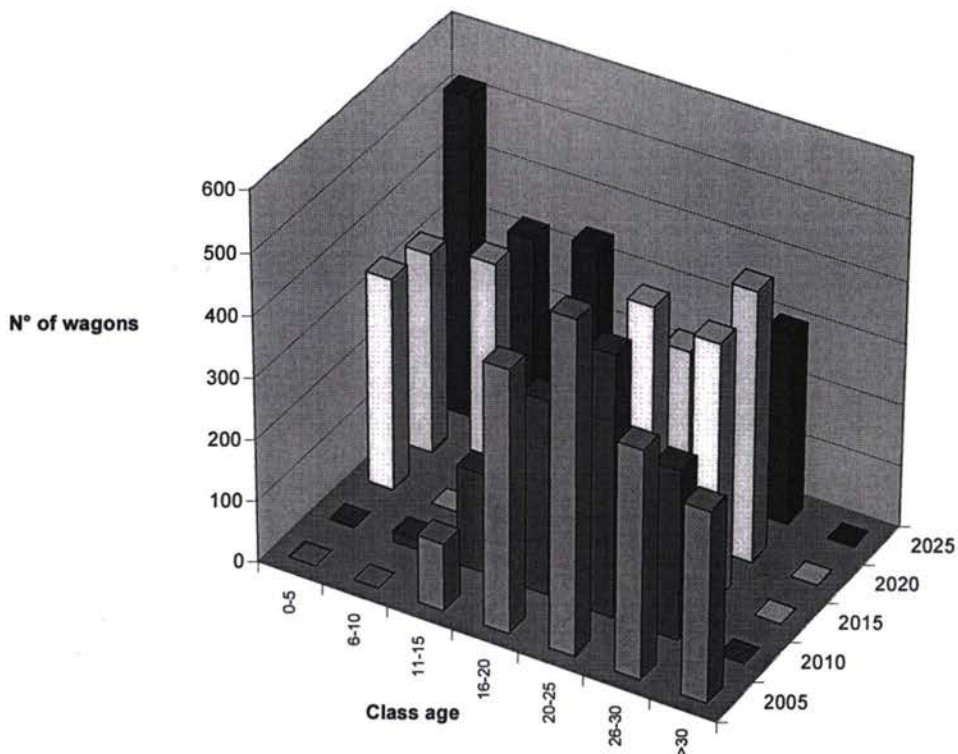
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Table 2. - Phase 2 - Investment cost estimate (USD at 2005 prices)

	Foreign costs	Local costs	Total costs
Purchased of new wagons	59.693.235	-	59.693.235
Conversion of freight wagons	-	-	-
Refurbishment of freight wagons	6.910.764	141.036	7.051.800
Workshop rehabilitation	-	-	-
Purchase of workshop equipment	-	-	-
TOTAL	66.603.999	141.036	66.745.035

As a result of the mentioned strategy, at the end of Phase 2 the age mix of the wagon fleet should result as shown in figure 1

Figure 1 – Wagon fleet age distribution



1. BACKGROUND

This Report is part of the EUROPEAID funded Project " Review of railway rehabilitation in Central Asia", which deals, among the others, with the identification of possible rail investment opportunities in the area, eligible to IFIs financing.

During a Project co-ordination seminar held in Tashkent on 18th-19th November 2004, Tajik Ministry of Transport and Tajik Railways made request and discussed with EU and with the Consultant the opportunity to include, among the envisaged activities of Module B, a technical assistance for the definition of an optimal policy of wagon fleet renewal and relevant re-organisation of maintenance activities in Tajikistan.

At the end of february 2005, the Consultant was formally appointed by EU to develop a feasibility study of measures for the rehabilitation and renewal of the freight wagon fleet of Tajik Railways.

The following basic tasks were agreed upon:

- Collection of data on existing situation of the freight wagon fleet, including maintenance facilities and relevant organisation
- Definition of future needs of the Tajik railways in terms of wagon fleet size and composition
- Development of optimal scenarios for wagon maintenance, rehabilitation and renewal
- Estimate of investment needs and selection of the most recommended option
- Preparation of tender documents for the rehabilitation and renewal of existing workshops
- Preparation of technical specifications for a project of technical assistance to the Tajik Railways for the procurement of wagons.

The Study execution progressed as follows:

- A preliminary request for statistical data was submitted to the Beneficiary in March 2005;
- A first site mission to Tajikistan was undertaken in April 2005 for visiting the existing/under construction workshops and for monitoring the data collection process;
- A second mission to Tajikistan was performed in June 2005 to speed up the data collection process;
- Two discussion notes were submitted to the Beneficiary's attention in May 2005 and August 2005 in order to validate input data and to share progress and preliminary results of the Study, respectively.

2. TAJIK RAILWAYS AND FREIGHT TRANSPORT MARKET

As in any other CIS country, Tajikistan experienced, since the collapse of the Former Soviet Union, a dramatic decline in freight transport. Apparently, the downward trend continued even after the end of the civil war: in the period 1997-2002, according to latest available official statistics from the Ministry of Transport, freight volumes decreased from 16.0 to 14.0 million net tons, with rail accounting for around 85% of the goods transport market (more than 95% in terms of ton-km).

Table 3. - Freight distribution within Tajikistan – Modal market share (000 net tons)

000.net tons	1997		1998		1999		2000		2001		2002	
Rail	13194	82,6%	12706	76,9%	11638	80,5%	13102	82,3%	12714	83,8%	11777	84,0%
Road	2773	17,4%	3802	23,0%	2815	19,5%	2815	17,7%	2463,3	16,2%	2236,8	16,0%
Air	4	0,0%	4	0,0%	2	0,0%	2	0,0%	2,5	0,0%	2,4	0,0%
Total	15971	100%	16512	100%	14455	100%	15919	100%	15180	100%	14016	100%

Source: Tajikistan National Statistic (2003)

Table 4. - Freight distribution within Tajikistan – Modal market share (million net ton-km)

Million of net Ton per Km	1997		1998		1999		2000		2001		2002	
Rail	1384	95,9%	1458	95,5%	1282	96,0%	1326	97,3%	1296	96,6%	1086	95,8%
Road	51	3,5%	60	3,9%	48	3,6%	33	2,4%	41	3,1%	42	3,7%
Air	8	0,6%	9	0,6%	5	0,4%	4,3	0,3%	5,1	0,4%	5,7	0,5%
Total	1443	100%	1527	100%	1335	100%	1363	100%	1342	100%	1134	100%

However, data require a more detailed analysis:

- road traffic declined over the considered five-year period at an average yearly rate of -1.7%, due in great part to the low competitiveness of road transportation, serviced by an old truck fleet (according to TRACECA reports, more than 80% of available fleet has expired its useful life) and operating on an obsolete road network with a great maintenance backlog
- rail traffic decreased at an average yearly rate of 2%, but the figure may be misleading. In fact, a major share (around 80% in 2002) of rail volumes is represented by transit traffic of Uzbekistan crude and refined oil in northern Tajikistan (through the line Nau-Kanibadam), which strongly declined along the time due to the policy of Uzbek Government of providing an alternative route to oil products transportation to/from the Fergana Valley aimed at minimising transit through Tajikistan.

If attention is paid to more recent data provided by Tajik Railways, the picture of rail transport looks more promising. Between 1999 and 2004, rail import and export traffic (which account for more than 95% of total rail traffic, transit excluded) experienced an average yearly growth rate of +4,9% and +8.4% respectively.

Export traffic was highly concentrated on two commodities, aluminium and cotton, which accounted for more than 75% of the total. Import traffic was mainly made by alumina and petroleum products (65% of the total). The split of international rail traffic by commodity is reported in the following table.

Table 5.- Volume loaded/unloaded during the year ('000 tons) by commodity

Commodity group	Volume loaded / unloaded during the year ('000 tons)					
	1999	2000	2001	2002	2003	2004
Export						
Aluminium	226,1	278	289,8	307,2	319,2	344,3
Cotton	109,7	88,4	83,7	137,6	149,7	130,3
Fruits and Vegetables	30,4	44,6	49,5	55,7	49,2	57,9
Scrap metal	4,8	10,1	19,8	81,2	28,4	2,1
Other foodstuff	30,1	77,7	122,2	124,3	104,9	87,9
TOTAL	401,1	498,8	565	706	651,4	622,5
Import						
Alumina	457	542,8	539	606,2	511,2	667,1
Petroleum products	428,1	338,5	434,4	434,6	685,4	596
Fertilizer	55,3	84,2	97,3	88,9	115,3	148,9
Cement	75,9	99,8	92	44,5	45,5	157,5
Grain	337,6	364,6	357,1	293,5	159,8	145,8
Flour	131,8	115,9	206,4	239,6	279,5	256,8
TOTAL	1485,7	1545,8	1726,2	1707,3	1796,7	1972,1
TOTAL IMPORT+ EXPORT	1886,8	2044,6	2291,2	2413,3	2448,1	2594,6

Source: Tajik Railways

No data expressed in ton-km were supplied.

Although no data on main origin/destination of traffic were made available, the following exports patterns recorded by Tajikistan in 2003 may give an indication of the main direction of outwards international trades (90% of which are served by rail)

Table 6.- Main destination of export traffic by commodity
(2003)

	CSI Country					No CSI Country					
	Russian Federation	Uzbekistan	Ukraine	Turkmenistan	Others	Turkey	Netherlands	Iran	Latvia	Switzerland	Others
Aluminium	0%	8%	0%	2%	1%	30%	56%	0%	0%	0%	3%
Cotton	16%	0%	4%	0%	1%	0%	0%	10%	20%	26%	23%
Fruit and Vegetables	99%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%

In terms of predominant routes, it is estimated that the central line (running from Patahabad at the Uzbek border to Yangibazar via Dushanbe) handles around 48% of total import-export freight traffic, against a 33% served by the northern line (from Bekabad to Kanibadam via Kudjand) and a 19% passing through the southern line (from Hashidy at the Uzbek border to Kulyab via Kurgan Tyube).

This pattern substantially reflects the location of the main industrial and agricultural activities. The most significant industrial site, the Aluminum Smelter, is located at Tursunzoda, west of Dushanbe while cotton grows on irrigated lands along the tributaries of the Amu Darya and Syr Daria, both in central and northern Tajikistan.

3. THE WAGON FLEET

At 2005, the wagon fleet of Tajik railways consists of 1756 vehicles with the following distribution by type and age:

Table 7.- Actual age distribution of wagons fleet by type

Wagon Type	Total fleet at May 2005	Age distribution of total fleet in 2005 (years)						
		0-5	6-10	11-15	16-20	20-25	26-30	>30
Covered	406			14	86	89	101	116
Platforms	188			12	38	41	44	53
Open-wagons	406			38	129	119	81	39
Tanks	115			25	10	12	28	40
Refrigerator	140			13	37	89		1
Other:	501			8	126	190	116	61
<i>Hopper-batcher</i>	18				2	1	10	5
<i>Engine-room</i>	49				9	35	5	
<i>Mineral wagons</i>	3			1		2		
<i>Truck tractor</i>	21			2	4	3	10	2
<i>Hopper-cement</i>	116				26	23	29	38
<i>Tank-cement</i>	14					8	5	1
<i>Grain carrier</i>	138				65	56	17	
<i>Transporter wagon</i>	3				1	1	1	
<i>Reequipped</i>	70					50	20	
<i>Fitting</i>	46			5	19	11	7	4
<i>Other</i>	23						12	11
TOTAL	1756			110	426	540	370	310

It is to be noted that the total fleet size has decreased from 2320 vehicles in 1995 and 2206 in 2000 to the present level, experiencing therefore a drop-out rate of 5% in the period 1995-2000 and 20% in the last five years.

Most of the wagon fleet is characterised by 4-axle wagons with approx. 22 tons tare weight and maximum load capacity varying from 50 to 70 net tons, depending on the transported commodity.

Today, according to official data provided by Tajik Railways, 1405 wagons result to be available for operation, with the following detail by type:

Table 8. - Available fleet by type

Wagon Type	Total fleet at May 2005	
	Count	Percentage
Covered	275	19,6%
Platforms	117	8,3%
Open-wagons	357	25,4%
Tanks	105	7,5%
Refrigerator	140	10,0%
Other:	411	29,3%
<i>Hopper-batcher</i>	17	
<i>Engine-room</i>	14	
<i>Mineral wagons</i>	2	
<i>Truck tractor</i>	7	
<i>Hopper-cement</i>	97	
<i>Tank-cement</i>	14	
<i>Grain carrier</i>	129	
<i>Transporter wagon</i>	3	
<i>Reequipped</i>	70	
<i>Fitting</i>	39	
<i>Other</i>	19	
TOTAL	1405	100,0%

The existing operating fleet is reported by Tajik Railways to be hardly able to meet the requirements of domestic and export traffic.

In particular, export traffic calls largely for covered and open wagons, which constitute only 45% of the total fleet. Moreover, these vehicles have an age profile rather imbalanced towards older units (25% of them have exceeded their useful life).

As a result, Tajik Railways, in order to provide an adequate service to freight customers, are obliged to resort to wagons hired from neighbouring countries.

According to Tajik Railways, only around 800-900 wagons represent today the core fleet effectively used.

There is also perception within Tajik Railways that there is a requirement for 1.000 new wagons from now to 2010 (700 covered and 300 open), with a corresponding number of old wagons to be scrapped.

4. CURRENT WAGON MAINTENANCE FACILITIES AND ORGANISATION

4.1. WAGON MAINTENANCE EXISTING FACILITIES

At present Tajik Railways utilise two workshops for freight wagon maintenance operations, both for preventive and corrective maintenance. One is located on the central line at Dushanbe, the other on northern line at Makhram.

A new workshop also dealing with wagon maintenance is under construction, at the southern line, at Kurgan - Tyube.

In the following, workshop facilities and main production data are reported according to the information collected during the visit held in April 2005.

4.1.1 Dushanbe wagon depot

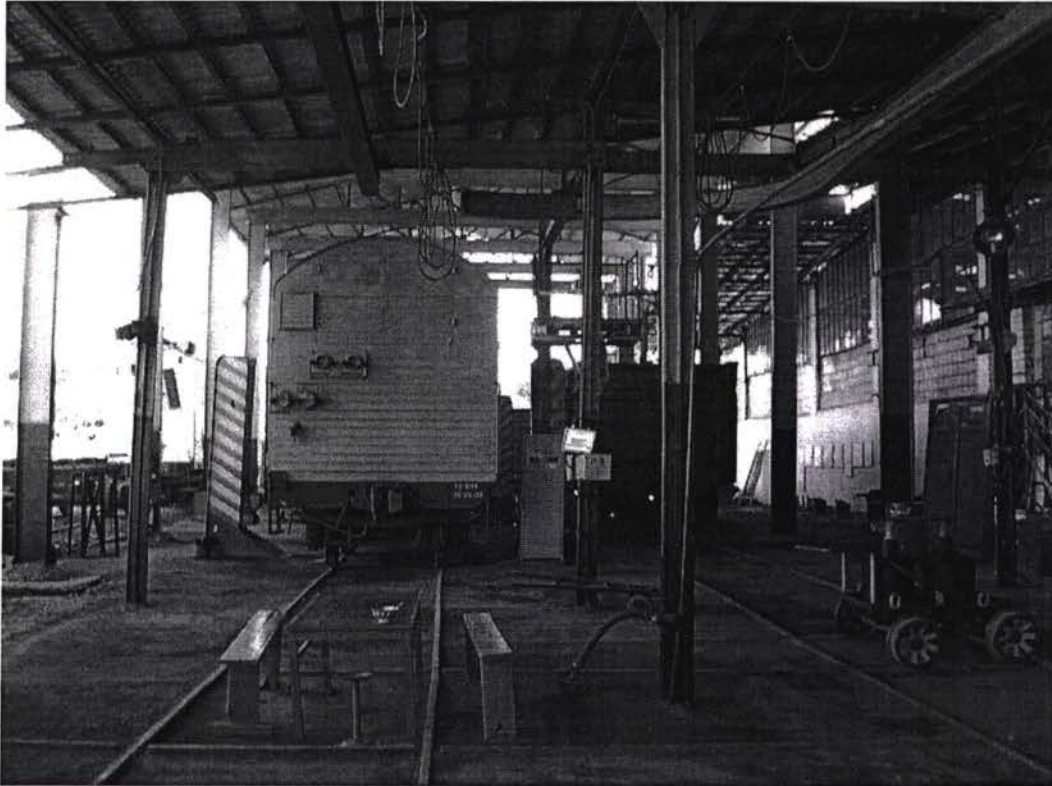
Dushanbe wagon maintenance depot is a small sized facility located in the Central area of Tajikistan.

Presently the following activities are performed in Dushanbe depot:

- minimal capital maintenance on some types of wagons (covered wagons and open wagons) and refurbishment of refrigerated units which are transformed into covered wagons to be utilized for cotton transport.
- Running and depot maintenance of wagons.

The depot consists of three tracks, two of which covered by a steel shed whose dimension is approximately 60m x20m.

Photograph 1 – Dushanbe depot – Covered tracks



One of these tracks is served by two sets of four lifting jacks.

The two covered tracks are dedicated to car-body repair operations, such as metal sheets welding, car-body parts replacement and coupling head disassembling.

The welding process is carried out with traditional electrode welding machines and for the disassembling operations there is lack of pneumatic tools.

Photograph 2 – Dushanbe depot – wheel re-profiling site



The third uncovered track is dedicated to wagon parking.

For the repair operations on sub-assemblies, the following workshops exist:

- Wheel set repair: the main equipment consists on a wheel re-profiling lathe (Rafamet, Poland) presently out of order and a CNC lathe in quite good conditions.
- Light machine tools workshop: the main equipment consists on two lathes, one drilling machine and one milling machine.
- Brake components repair and testing.
- Forging and welding for couplers and other steel components repair.

The manpower employed in the depot (not including staff employed in the maintenance point of the station and in other activities) amounts to 120 units (including administrative staff) part of which working on 12 hours after 2 days.

The main production in average volume/month is reported to be:

- 30 freight wagons for depot maintenance
- 260-300 freight wagons for running maintenance and occasional repair.

4.1.2 Makhram wagon workshop

The workshop is located in Northern Tajikistan.

It has been in operation for many years for the production of mechanical machines and in 1997 was converted into a wagon repair workshop.

The plant consists of many buildings for wagons and passenger coaches, on which capital, depot and running maintenance are performed.

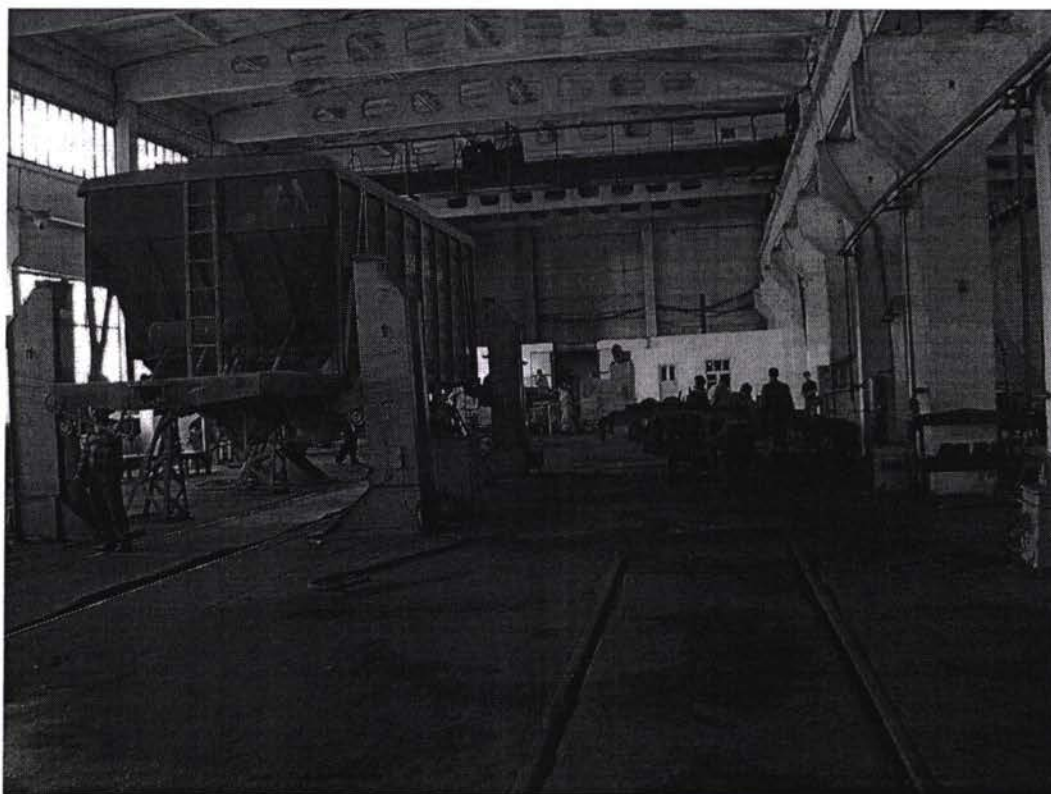
In particular, for wagons depot, running and light repair maintenance is carried on, due to the lack of some equipment necessary to accomplish the tasks requested by heavy repair.

The number of workers employed in the workshop is about 510 units, including administrative and technical direction staff.

The usual operation time is 12 hours per day, 7 days a week.

The main maintenance building is provided with four tracks served by two overhead beam cranes where car body repairs are carried out, including the repair and replacement of metal sheets parts. One of these tracks is served by two sets of four lifting jacks.

Photograph 3 – Makhram workshop – Tracks with lifting jacks



Metal sheets are cut and shaped in a dedicated workshop, carried in the main maintenance building and welded with traditional electrode welding process.

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For assembling and disassembling operations it has been noted lack of portable pneumatic tools.

The building is equipped with a wheel re-profiling lathe and with a washing machine for axle box bearing and with bogies disassembling /assembling areas.

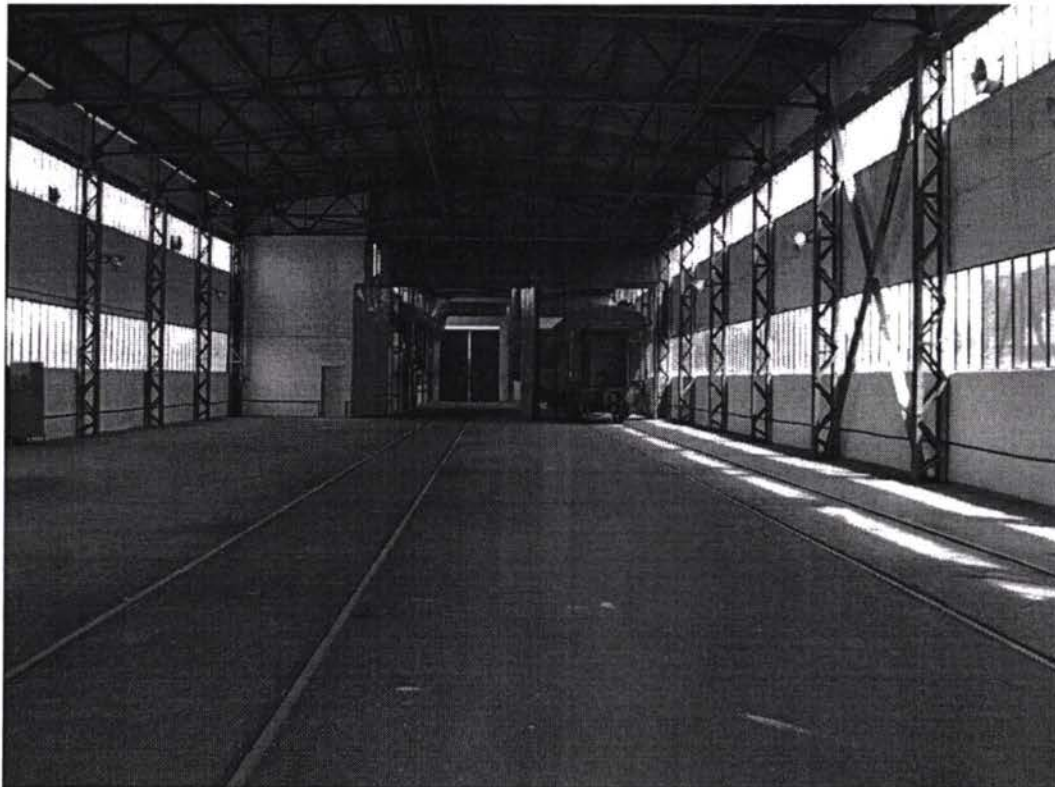
In these areas there is no equipment for the disassembling /assembling activities such as bogies washing machines, bogie frame measuring bed, spring press, bogie press, shock absorbers testing machine. All the bogie repair and control operations are therefore still performed manually.

For wheel replacement operations the workshop is not equipped with the necessary coupling and uncoupling press and machinery and therefore it is necessary to send wheel sets to foreign countries (i.e. Uzbekistan).

The first track of the main building is equipped with two sets of lifting jacks.

The workshop also dispose of a second smaller building equipped with two tracks . This second building is actually almost empty, except for the heating and ventilation system dedicated to painting operations on coaches. The removal of the old painting is carried on by a manual sandblasting unit in an open track site.

Photograph 4 – Makhram workshop – Painting building



The building requires to be fully equipped for coaches repair operations.

Once equipped, passenger coaches maintenance repair operations will mainly take place here and the main maintenance building will be entirely dedicated to wagon maintenance operations.

Another building is dedicated to wood parts construction and repair (window frames, floor covering, doors, etc.

Other buildings existing in the plant area are equipped with many machines, such as grinding machines, milling machines, lathes, drilling machines, slotting machine, gear cutting machine and many others, in quantity and type.

Photograph 5 – Makhram workshop – Presses building



A large building is also equipped with many presses and machines for trimming and bending metal sheets, up to 12 mm. thickness.

All this equipment, not usual to find in a wagon repair workshop, was utilised in the past years, when the factory was dedicated to different mechanical production activities.

These machines are presently in part utilised for the repair of mechanical parts stripped from the wagons and for the construction of new spare parts. For the construction of spare parts it has been reported that there is no problem about technical information and there is complete availability of the necessary technical specification and drawings.

The workshop includes also a centralised compressor equipment, a general store and other minor buildings for brake equipment controls and repair, for seats repair, etc..

The workshop is sized for the performance of capital maintenance on 30 wagons and 3 passenger coaches of all types every month.

For what concern wagon repair costs, the share for labour cost is roughly estimated around 20%, while the share for spare parts is around 80%, due to the fact that a large amount of spare parts are purchased abroad (Russia, Uzbekistan and other CIS Countries).

On average, 300 man-hours are employed for each wagon capital maintenance intervention.

Running maintenance operation and occasional repair are also performed on around 50 wagons/month. On average, 100 man-hours are employed for each running maintenance operation.

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For tank wagons there is no equipment necessary for tank controls and repair and, once the maintenance works are completed for body structure and bogies, the wagon has to be sent abroad for the works and controls regarding the tank.

It was reported that the workshop is completely equipped for executing the works necessary for wagons life extension according to CIS regulations. There is however lack of skill and tools for measuring, final testing and controls on the wagons after the completion of works for life extension.

4.1.3 Kurgan-Tyube wagon depot

The workshop is located in Southern Tajikistan.

It is presently under construction and the estimated completion time for the civil works is approximately foreseen for December 2005.

Regarding the equipment, Tajik Railways presented to the Consultant a list of the machinery considered necessary for the workshop. It was underlined that there is presently lack of financial resources for their purchase.

Photograph 6 – Kurgan-Tyube depot – Main maintenance building



Once this depot is operational, capital maintenance, depot and running maintenance may take place both for passenger coaches and freight wagons.

The plant consists of a main maintenance building provided with 4 covered tracks on which the maintenance operation will occur.

Two tracks should be dedicated to the capital maintenance on wagons (and coaches), the other two tracks to the depot and running maintenance operations on wagons (and coaches).

In the same building several workshops for performing the needed maintenance operations on sub-assemblies will be located. Other facilities are foreseen in the external area both relevant to the auxiliary technological systems and to recreation for the workers.

Photograph 7 – Kurgan-Tyube depot – Workshop



The wagon depot is sized for the performance of capital maintenance on 500 freight wagons of all types every year.

Capital maintenance operations are envisaged on 36 passenger coaches/year.

Running maintenance operation and occasional repair will be performed on 700 freight wagons/year and on 180 passenger coaches/year.

The number of workers foreseen for this maintenance depot is about 150 units, out of 320 units employed in auxiliary activities in the workshop and in the maintenance point of the freight station.

4.2 WAGON MAINTENANCE ORGANISATION AND PERFORMANCE

4.2.1 Maintenance operations

Maintenance operations are performed according to CIS rules, due to the fact that almost the entire wagon fleet has to be allowed to travel abroad and has therefore to respect the maintenance intervals and schedule defined in the CIS agreements for wagon exchange.

Preventive maintenance for wagons is basically divided into three different levels, also if different patterns apply according to each wagon type:

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- Inspection Level, named TO1, TO2 and TO3 (defined, to the purpose of the study, "running + depot maintenance")
- Light Maintenance Level, named TR1 and TR2
- Heavy Maintenance Level or Capital Maintenance , named KR1 and KR2

Inspection level TO1 is performed in station or yard before wagon loading

Inspection level TO2 is performed in station or yard after wagon loading

Inspection level TO3 is performed in depot or yard every 6 months

Light maintenance TR1 is performed in depot on request in case of abnormal behaviour or suspected damages

Light maintenance TR2 is performed in workshop every year. TR2 is not carried out in the first two years after KR1 or KR2.

Heavy maintenance KR1 is performed in workshop every 5 years for refrigerator wagons only.

Heavy maintenance KR2 is performed in workshop every 8 years for other types of wagons

4.2.2 Maintenance performance

According to data collected during the site visit, the following production volumes (expressed in direct man-hours) are spent in the different facilities:

DUSHANBE

- 2.800 man-hours per month for wagon running maintenance
- 4.500 man-hours per month for wagon depot maintenance

MAKHRAM

- 5000 man-hours per month for wagon depot and running maintenance
- 9000 man-hours per month for wagon light capital maintenance
- 6000 man-hours per month for passenger coaches capital maintenance
- 3000 man-hours per month for passenger coaches running maintenance (estimated amount)

Summarising, a total of around 276.000 direct man-hours per year are allocated to maintenance operations, out of which 168.000 for wagons.

KURGAN-TYUBE (planned)

- 6000 man-hours per month for wagon depot and running maintenance
- 12.500 man-hours per month for wagon capital maintenance
- 6000 man-hours per month for passenger coaches capital maintenance

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- 3000 man-hours per month for passenger coaches running maintenance (estimated amount)

Total direct man-hours per year planned to be allocated to wagon maintenance operations: 222.000 (out of 330.000)

The present total workload for wagon maintenance seems to be around 256.000 direct man-hours per year.

By comparison, a typical maintenance workload for a Western European railway company with a wagon fleet of around 2000 units is the following:

Capital maintenance

6 years interval between two major interventions (named R.O.), which leads to $2000/6 = 333$ R.O. per year at a cost of around 150 direct man-hours each, which means around 50.000 direct man-hours per year.

Running and depot maintenance

Around 20 direct man-hours per wagon per year, which means around $2000 \cdot 20 = 40.000$ direct man-hours per year.

The total amount of requested man-hours for the entire wagon fleet may be estimated therefore in around 90.000 direct man-hours per year.

The difference with Tajik standards could be explained by the following reasons:

- different preventive maintenance schedule and redundancy of preventive maintenance operation in the CIS countries schedule, also due to different level of technology and reliability and quality of main components (wheel sets, axle box bearings, brake valves, etc.)
- lack of modern process equipment able to reduce manual operation (washing machines for bogies, wire welding machines, pneumatic tools, etc.)
- significant maintenance works done to foreign wagons in addition to the domestic fleet needs
- suboptimal allocation of available resources

5. FUTURE EXPORT AND DOMESTIC RAIL FREIGHT VOLUMES

In order to estimate future requirements of fleet size and composition, a twenty-year forecast of freight transport volumes has been carried out, with particular reference to export and domestic traffic which will represent the driver for the future wagon fleet dimensioning.

The forecast has taken into consideration the prospect of future competitiveness of rail in the Tajik transport market.

In this respect, it must be mentioned that official transport statistics appear rather incomplete since there is no good understanding of the road sector (according to TRACECA studies, around 65% of road operations are left out of account).

However, the nature of transported goods and the very long average haulage distances over international routes make presently rail as the most cost effective mode of transport, especially in the light of the very poor state of road infrastructure and services.

Even if significant investments (funded by bi-lateral and multi-lateral initiatives IFIs)¹ are being allocated to road transport, there is perception that they will be likely to produce their effects only in the long term.

As a matter of fact, out of the 26.000 km of the total road network, around 82% is made by local road (mostly rural and farm) against an 18% of national connections. Of the national roads, only 42% are asphalt, 50% are other pavement and 8% are gravel. On the overall, in Tajikistan only 20% of roads are estimated to be in fair condition, against 48% in poor condition and 32% in very poor conditions.

The road maintenance backlog of the 4700 km of national roads is so serious that an annual requirement of 16 million USD has been calculated, which is almost twice the total road subsector budget

On the operation side, the Tajik Government is keen on encouraging private sector involvement in providing road transport services, but most of the truck fleet is old (65% with more than 10 years' age), with an average loading capacity not adequate to meet demand requirements.

It can be concluded that, although road transport competition will probably increase in the future, its capacity will remain modest and not suited to hauling the large volume of freight that constitute the majority of rail transport. On the other end, there is reason to believe that rail will increasingly suffer competition for lower volume, shorter-haul higher value goods where delivery speed is a greater requirement. But such products constitute only a minimal proportion of the present rail business.

As a result, the potential for Tajik Railways to retain present freight volumes and categories seems high, provided that railways will put into action all the necessary measures to maintain future customer loyalty.

The estimate of future rail export and domestic traffic has been conducted by :

investigating, according to availability of statistical data, the correlation between total exports and corresponding rail traffic volumes for those main commodities that constitute the bulk of rail business (aluminium and cotton fiber);

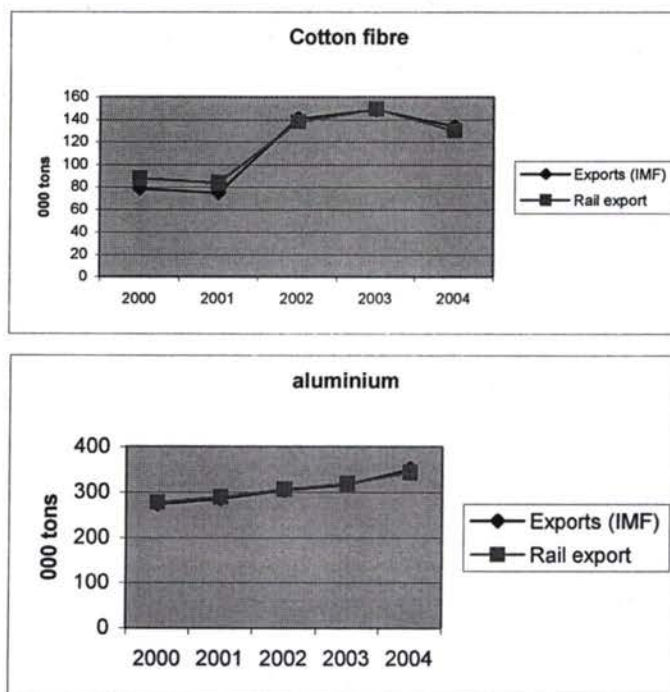
calculating an average implicit elasticity to GDP recorded by the main export and domestic commodities transported by rail in the last five years.

¹ For example the rehabilitation of the road connection between Dushanbe and the Kirgiz border (financed by ADB), the grant assistance for the partial construction of a tunnel linking the north and the south of the country (Iran) and the construction of the Shkev-Zigar road in the southeastern region (financed by Kuwait Fund, Saudi Fund and OPEC Fund).

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The following graphs indicate clearly how strictly rail exports of aluminium and cotton fibre are correlated to corresponding total outwards trades recorded in the last five-years.

Fig. 1 – Correlation to export and production



Growth forecast of exports by main commodity have been estimated by making reference to GDP growth prospects, as indicated by IFIs, to which the following elasticity factors (based on historical trends) have been applied:

Table 9.- elasticity between GDP and export

	Average Growth 2000- 2004	Implicit elasticity to GDP
GDP	9,7%	
Export of alluminium	9,0%	0,93
Export of cotton fibre	7,1%	0,73
Export of fruit and vegetables	*10,9%	1,13
Export of other foodstuff	6,8%	0,70

* Estimate based on production trends

Two GDP growth scenarios have been assumed, differentiated depending on the likely medium-long term success of the domestic policy reforms and institutional changes that the Tajik Government is undertaking:

Table 10.- GDP growth scenarios

	2005*	2006*	2007*	2008	2009	2010	2011-2025	
Low growth Scenario	8,0%	6,8%	5,9%	6,0%	6,0%	6,0%	4,0%	4,0%
High growth Scenario	8,0%	6,8%	5,9%	8,0%	8,0%	8,0%	6,0%	6,0%

*ADB estimates

Here following the forecasts of export and domestic rail freight transport by commodity is reported.

Table 11.- High growth scenario - Export and domestic rail freight forecast (000 net tons)

	2010	2015	2020	2025
<i>Export</i>				
Alluminum	514	675	675	675
Cotton fiber	179	222	276	342
Fruit and Vegetables	94	131	181	252
Other	119	147	180	222
<i>Domestic</i>	23	29	33	37
Total	929	1.204	1.345	1.528

Table 12.- Low growth scenario - Export and domestic rail freight forecast (000 net tons)

	2010	2015	2020	2025
<i>Export</i>				
Alluminum	488	586	678	678
Cotton fiber	172	199	230	265
Fruit and Vegetables	88	110	137	171
Other	115	132	151	174
<i>Domestic</i>	22	22	23	24
Total	885	1.049	1.219	1.312

It is to be mentioned that, in high growth scenario, exports of aluminum have been assumed to remain stable from 2015 due to the capacity constraints of aluminum production in Tursunzoda plant.

6. FUTURE WAGON FLEET REQUIREMENTS

Based on the freight demand forecasts, the following projections of wagon requirements by category in the next twenty years have been formulated:

Table 13.- High growth scenario - Future wagon fleet requirements

Category of wagon	2010	2015	2020	2025
Covered	683	881	944	1022
Platforms	0	0	0	0
Open-wagons	93	122	122	122
Tanks	0	0	0	0
Refrigerator	49	67	94	130
Other	160	199	241	292
Total	985	1270	1400	1566

Table 14.- Low growth scenario - Future wagon fleet requirements

Category of wagon	2010	2015	2020	2025
Covered	650	772	893	935
Platforms	0	0	0	0
Open-wagons	88	106	123	123
Tanks	0	0	0	0
Refrigerator	46	57	71	89
Other	155	182	208	238
Total	939	1116	1294	1384

These estimates have been carried out on the basis of the following future target operational performances:

Table 15.- Wagons operational performances by type

Category of wagon	Average wagon load (tons)	Wagon turn around time (days)	Reserve fleet factor
covered	40	15	1,1
platforms	30	15	1,1
open-wagons	50	15	1,1
tanks	30	15	1,1
refrigerator	35	15	1,1
other	40	15	1,1

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Although no data on current wagon turn around time have been made available by Tajik Railways, the Consultant estimates that the above mentioned relevant parameter reflects a 20-25% decrease to the current wagon utilisation levels.

To the purpose of estimating the future scenarios of wagon fleet rationalisation, reference has been made to the high growth scenario, so as to provide a comfortable margin for unforeseen upturns in future traffic.

7. SCENARIOS FOR WAGON FLEET DEVELOPMENT AND MAINTENANCE ORGANISATION

7.1 TECHNICAL ANALYSIS

7.1.1 Wagon fleet renewal options

To meet the requirements of a fully operational fleet of around 1570 wagons at 2025 as reported in § 6, two scenarios for the renewal of the current wagon fleet have been developed.

Both scenarios have been formulated by taking into account the progressive ageing of the current fleet and the need to rebalance the fleet size and composition in accordance with the market requirements.

Scenario A

Scenario A envisages the progressive refurbishment of part of the existing wagon fleet to prolong its useful life and/or to convert it in order to meet future demand at least investment costs. Some acquisition of new wagons is also assumed, due to:

- the physiological drop-out rate of the existing and the future refurbished (life-extended) fleet;
- the technical impossibility to convert/refurbish all wagons which result life-expired or unable to meet future demand requirements, due to the poor state of the vehicles belonging the older class ages;
- the mismatching between refurbishment/conversion rate and drop-out rate of wagons

The proposed fleet rationalisation strategy in the next 20 years rests on the following guide-lines:

- 40% of those wagons able to meet market requirements (covered, open and "other") which will be life-expired in the first five years (2005-2010) will undergo refurbishment works allowing a 10-year prolongation of their useful life;
- the same approach will be applied to the 70% of those wagons belonging to the same fleet category which will be life-expired in the period 2010-2020 and to the 100% of those life-expired in the last five years (2020 – 2025);
- the existing refrigerator fleet will be in part converted into covered wagons (45 wagons) and in part utilized for export traffic during the first five years . Due to the age profile and to the old technology, no life-extension will be performed. From 2010 a limited number of new generation refrigerated wagons will be purchased to meet the demand of perishable goods.
- those "other type" wagons (246) and open wagons (161), which exceed market requirements will be converted into covered wagons.
- From 2010 the residual gaps in the fleet size will be filled by purchases of new wagons.

From the technical point of view, a list of the main works proposed for life extension and overhaul is reported in § 7.

As a result of the mentioned strategy, the following wagon fleet will be available at the end of 2025:

Table 16.- Scenario A - Future wagon fleet size and composition

Wagons	2010	2015	2020	2025
Refurbished	103	227	302	352
Converted	452	452	366	15
Purchased	0	346	675	1199
Old	635	353	95	0
Total Fleet	1190	1379	1438	1566
Scrapped	566	724	993	1375

The expected change in the age mix of the fleet will be as follows:

Table 17.- Scenario A - Age distribution of the wagon fleet

	0-5	6-10	11-15	16-20	20-25	26-30	>30	<i>Total Fleet</i>
2005	0	0	110	426	540	370	310	1756
2010	0	15	161	315	424	275	0	1190
2015	344	0	15	161	442	417	0	1379
2020	328	344	0	15	308	442	0	1437
2025	525	328	344	0	61	308	0	1566

Scenario B

Scenario B implies an accelerated programme of disposal of unserviceable and life-expired wagons which would be replaced by the purchase of new generation of wagons.

The fleet rationalisation approach may be summarised as follows:

- all wagons more than 30 years old are scrapped at life expiry
- no life extension and conversion works are performed
- during the first five years period (2005-2010) all categories of wagons not suitable to market needs, regardless their age, are scrapped (refrigerated units and platform wagons)
- all the other existing wagons remain in operation till the end of their useful life
- the yearly gap between available and required wagons by category is covered by the purchase of new wagons.

As a result of the mentioned strategy, the following wagon fleet will be available at the end of 2025:

Table 18.- Scenario B - Future wagon fleet size and composition

Wagons	2010	2015	2020	2025
Refurbished	0	0	0	0
Converted	0	0	0	0
Purchased	543	943	1340	1566
Old	744	412	97	0
Total Fleet	1287	1355	1437	1566
Scrapped	1012	1344	1659	1756

The expected change in the age mix of the fleet will be as follows:

Table 19.- Scenario A - Age distribution of the wagon fleet

	0-5	6-10	11-15	16-20	20-25	26-30	>30	<i>Total Fleet</i>
2005	0	0	110	426	540	370	310	1756
2010	543	0	0	97	315	332	0	1287
2015	400	543	0	0	97	315	0	1355
2020	398	400	543	0	0	97	0	1437
2025	226	398	400	543	0	0	0	1566

7.1.2. Wagon Maintenance facilities and relevant organisation

7.1.2.1. General aspects

In order to rationalise and improve the operation of the future wagon fleet, appropriate changes in the overall wagon maintenance process will be needed, both on the side of the role of each maintenance facility and the modernisation of the equipment.

A basic assumption, common to the two Scenarios, is that for a fleet size not exceeding 1800 units it is not estimated as reasonable to fragment capital maintenance resources and capabilities, but it is considered wiser to concentrate them so as to avoid redundant costs and to get more effective performances.

7.1.2.2. Scenario A

As a consequence of the fleet renewal strategy outlined in § 7.1.1, Project Option A will imply a numbered activities to be performed in the workshops:

- Running maintenance of operational wagons
- Depot maintenance of operational wagons

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- Light and heavy capital maintenance of operational wagons
- Life-extension works of life-expired wagons (refurbishment)
- Conversion works of unsuitable wagons

According to the plans of wagon fleet renewal and to the consequent changes in the overall fleet composition, the following workshop requirements, per year, can be quantified :

Table 20.- Scenario A - Estimate of conversion, refurbishment and preventive maintenance requirements (average n. of wagons in the period)

	2006 - 2010	2011- 2015	2016- 2020	2016- 2025
Wagon refurbishment	26	25	47	20
Wagon conversion	113	-	-	-
Running + Depot maintenance (TO)	1.305	1.278	1.367	1.507
Light maintenance (TR1- TR2)	1.305	1.278	1.367	1.507
Capital maintenance (KR)	163	160	171	188

In order to successfully meet these requirements, an appropriate strategy of re-organisation and upgrading of present workshops needs to be formulated, together with a relevant proposal of most desirable resource allocation.

In this respect, particular consideration should be given to the purchase of suitable equipment which is to be considered as a basic pre-requisite for the technical sustainability of the wagon fleet renewal programme.

The overall dimensioning of labour requirements is also a key input for formulating an adequate proposal of capabilities allocation.

For each category of workshop activity the following unitary work load in terms of direct man-hours may be estimated:

Table 21.- Scenario A - Estimate of average direct man-hours required for each maintenance activity (man-hours per wagon)

Wagon refurbishment	730
Wagon conversion	900
Running + Depot maintenance	80
Light maintenance (TR1- TR2)	180
Capital maintenance (KR)	300

The total man-hours requirements by kind of maintenance activities may be summarised as follows:

Table 22.- Scenario A - Estimate of direct man-hours required for each workshop activity
(average value in period)

	2006 - 2010	2011- 2015	2016- 2020	2016- 2025
Wagon life-extension	18.761	18.192	34.135	14.892
Wagon conversion	101.700	-	-	-
Running + Depot maintenance	104.426	102.264	109.371	120.526
Light maintenance (TR1- TR2)	234.958	230.094	246.084	271.184
Capital maintenance (KR)	48.950	47.936	51.267	56.497
total	508.794	398.485	440.856	463.100

The following allocation of workshop activities is proposed in scenario A:

Makhram Workshop

Makhram workshop should be the main wagon workshop, in charge of:

- all the capital maintenance works
- all the refurbishment works
- all the conversion works
- all the works necessary for repair of parts stripped from wagons and replaced in the other workshops (Dushanbe and Kourgan-Thube). In particular Makhram workshop should concentrate all the repair works on:
 - bogies
 - wheelsets
 - brake components
 - coupling equipment
- running maintenance and light repairs to the wagons of trains having origin or destination in the North of Tagikistan.

The key role of Makhram is due to the fact that Makhram is the largest and best equipped workshop in Tajikistan and has a large area for future expansion where tracks and industrial buildings are already available.

To perform its tasks Makhram shall be equipped with new maintenance installations and tools . A list of these equipment is reported § 7.2.1. A preliminary proposal of equipment allocation is shown in the functional lay-out reported in figure 2.

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With the availability of these equipment it will be possible to improve quality, efficiency and effectiveness of wagon maintenance works.

Makhram workshop shall have the best competence for wagon maintenance and some of its technical staff shall be trained to get the adequate skill for certification of life extension and conversion works on wagons.

Also the central store for wagon spare parts shall be located in Makhram and the other workshops will ask to it for their needs.

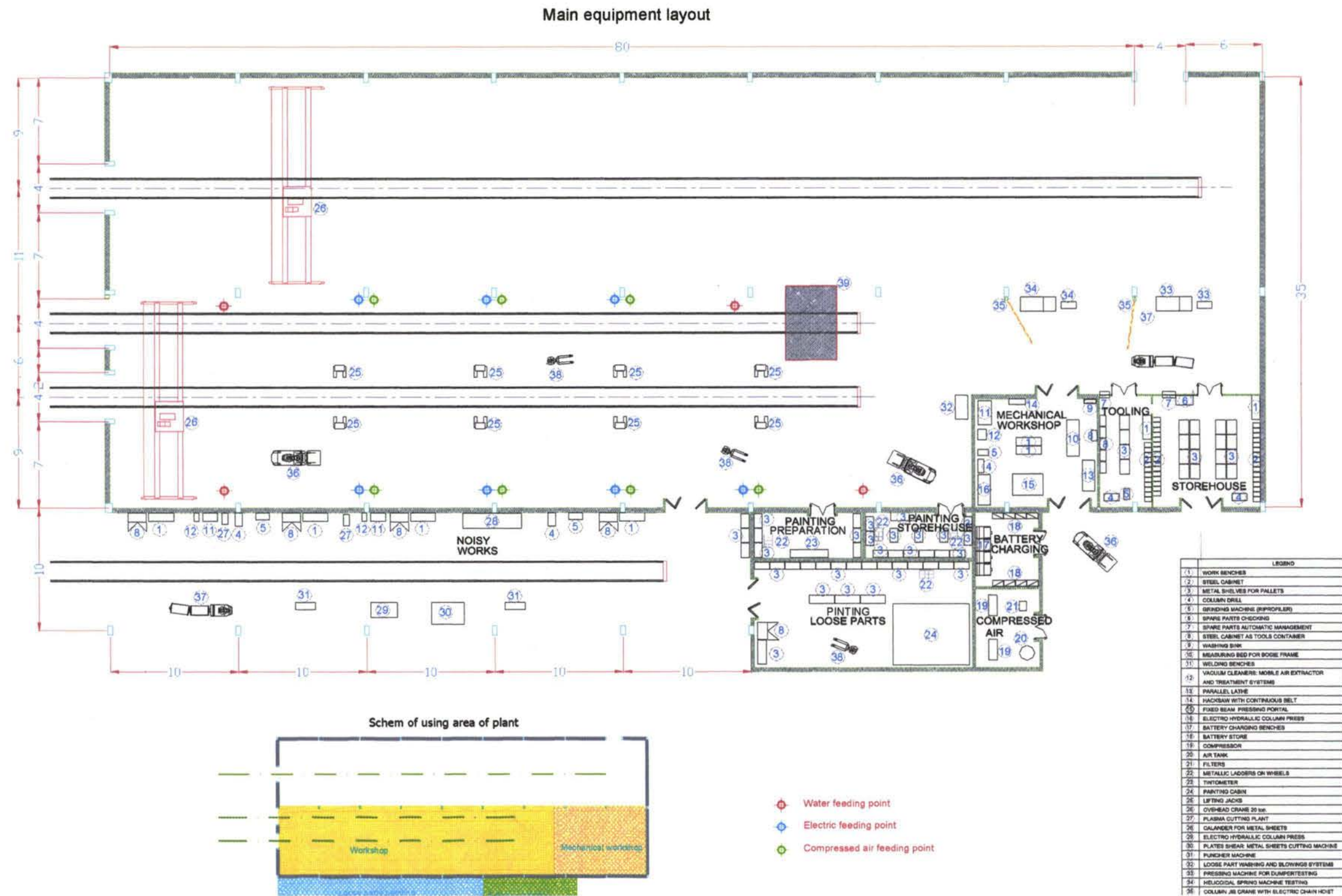
A typical work process for wagon capital maintenance shall include the following main operations and registrations, which are presently only in part carried on:

- preliminary examination and definition of the necessary works to be added to scheduled maintenance operations
- registration of the wagon work order
- complete wagon disassembly
- complete bogies washing and disassembly
- wagon underframe washing
- wagon frame examination and measurement
- wagon frame measures registration
- old paint removal from wagon frame
- examination of wagon frame welded parts, inspection for cracks and eventual repair with wire welding machine
- old paint removal from bogie frame
- bogie frame examination and measurement on bogie frame test bench
- bogie frame measures registration
- examination of bogie frame welded parts, inspection for cracks and eventual repair with wire welding machine
- suspension springs inspection for cracks and control under press
- springs data registration
- wheelsets disassembly
- axleboxes disassembly and washing
- axlebox inspection for cracks and eventual repair or replacement
- axlebox bearings and mechanical components washing and inspection for cracks and wear
- axlebox measurement and measure registration
- wheels and axle measurement and non destructive controls
- registration of wheelsets measurements and controls
- brake components disassembly
- brake components inspection, control and eventual repair or replacement
- brake components testing
- brake distributor valve testing and test registration

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- coupling equipment disassembly
- coupling equipment measurement and control and inspection for cracks and wear
- coupling equipment eventual repair with wire welding machine or metal spray equipment or replacement
- wagon floor examination for deformation and corrosion and repair or replacement of parts
- wagon superstructure examination for deformation, corrosion and welded parts conditions
- sheet panels and profiles repair or replacement
- replacing of all rubber and metal rubber parts with new or reconditioned ones
- axleboxes assembly
- wheelsets assembly
- bogie assembly
- wheelsets and bogies painting
- bogie test under press and registration
- wagon frame and superstructure painting
- brake components assembly on bogies and wagon
- coupling equipment assembly
- wagon and bogies connection
- brake system test and registration of tests and data
- functional test of coupling system
- functional test of wagons parts (doors, moveable roof, etc.)
- rain test (in case of covered wagons)
- special tests for particular types of wagons (tank wagons, refrigerated wagons, etc.)
- final wagon delivery to the station.

Figure 2 – Propose functional lay-our of Makhram workshop



Dushanbe

Dushanbe should progressively reduce and terminate all the capital maintenance and refurbishment works on wagons and limit its tasks to running maintenance and light repairs to the wagons of trains having their origin or destination in Central Tagikistan.

It has in fact to be considered that a small workshop for wagon repair should be made available, not only for Tagikistan Railways wagons, but also for foreign wagons coming in the Country with import freight trains which possibly need occasional repair before being sent back abroad.

In relation to its new mission, Dushanbe workshop should dismiss and transfer to Makhram its equipment for wheel reprofiling, its equipment for brake components testing and the other equipment non necessary for carrying on running maintenance and small failures repair.

Some new small equipment and tools should anyway be provided for Dushanbe, to renew and improve the present situation. The relevant list is presented in § 7.2.1.

Kourgan-Tyube

Kourgan-Thube workshop is presently under construction and its maintenance tasks will probably range from locomotives to passenger coaches and freight wagons maintenance works.

When completed and equipped, according to the proposed model, Kourgan-Thube could be a secondary wagon workshop, with a mission very similar to what proposed for Dushanbe:

- running maintenance and light repairs to the wagons of trains having their origin or destination in the South of Tagikistan
- only some minor capital maintenance works, in support to Makhram to cover occasional work overload.

In relation to this mission, and only with reference to maintenance works on wagons, only minor investments can be justified and consideration should be given to the opportunity of reserving only one covered track to wagons.

Some small equipment and tools should anyway be provided for Kourgan-Thube to put the workshop in condition of carrying on the requested tasks on wagons.

The relevant list, very similar to that prepared for Dushanbe workshop, is presented § 7.2.1

7.1.2.3.Scenario B

Scenario B will imply a maintenance organisation compliant with a fleet renewal programme centred on the purchase of new wagons.

The maintenance requirements will be limited to running , depot and capital maintenance operations and may be summarised as follows:

Table 23.- Scenario B - Estimate of conversion, refurbishment and preventive maintenance requirements (average n. of wagons in the period)

	2006 - 2010	2011- 2015	2016- 2020	2016- 2025
Running + Depot maintenance	1.474	1.303	1.414	1.515
Light maintenance (TR1- TR2)	1.474	1.303	1.414	1.515
Capital maintenance (KR)	184	163	177	189

For each category of maintenance works, the following unitary work load in terms of direct man-hours may be estimated.

Table 24.- Scenario B - Estimate of average direct man-hours required for each maintenance activity (man-hours per wagon)

Running + Depot maintenance	80
Light maintenance (TR1- TR2)	180
Capital maintenance (KR)	300

The total man-hours requirements by kind of maintenance activities may be summarised as follows:

Table 25.- Scenario B - Estimate of direct man-hours required for each workshop activity (average value in period)

	2006 - 2010	2011- 2015	2016- 2020	2016- 2025
Running + Depot maintenance	113.609	104.257	113.111	121.170
Light maintenance (TR1- TR2)	255.620	234.579	254.500	272.632
Capital maintenance (KR)	53.254	48.871	53.021	56.798
total	422.483	387.707	420.633	450.600

The mentioned work force will be allocated between the existing facilities according to the following policy of maintenance organisation.

The Consultant wishes to underline that ,in spite of the lower maintenance requirements and therefore the more limited needs of new equipment, no significant differences in the resource allocation between Scenario A and B are envisaged. This is due to the rather limited work load resulting from both Scenarios, which in any case would lead to considering the concentration of core maintenance activities in one facility as the most cost-effective solution.

Makhram

Makhram workshop should be the main wagon workshop and it should be in charge of:

- all the capital maintenance works

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- all the works necessary for repair of parts stripped from wagons and replaced in the other workshops (Dushanbe and Kourgan-Thube) and in particular in Makhram workshop should be centralized all the repair works on:

- bogies
- wheelsets
- brake components
- coupling equipment

- running maintenance and light repairs to the wagons of trains having origin or destination in the North of Tagikistan.

The reason for such proposal is the same expressed for A Scenario what is essentially in the fact that presently Makhram is the largest and best equipped wagon workshop and has a large area for future extension in which are already available tracks and industrial buildings.

Also in B Scenario the central store for wagon spare parts shall be located in Makhram and the other workshops will ask to it for their needs.

Dushanbe

As per A Scenario, Dushanbe should progressively reduce and terminate all the capital maintenance and refurbishment works on wagons and limit its tasks to running maintenance and light repairs to the wagons of trains having their origin or destination in Centre Tagikistan.

In relation to its new mission Dushanbe workshop should dismiss and send to Makhram, its equipment for wheel reprofiling, its equipment for brake components testing and the other equipment non necessary for carrying on running maintenance and small failures repair.

Kourgan-Tyube

Also in B Scenario, when completed and equipped, Kourgan-Thube could be a secondary wagon workshop, with a mission very similar to what proposed for Dushanbe:

- running maintenance and light repairs to the wagons of trains having their origin or destination in the South Region of Tagikistan
- only some minor capital maintenance works, in support to Makhram to cover occasional work overload

Some small equipment and tools should anyway be provided for Kourgan-Thube to put the workshop in condition of carrying on the requested tasks on wagons.

The relevant list of equipment, very similar to that prepared for Dushanbe workshop, is presented in § 7.2.1

7.1.2.4. Recommended actions

7.1.2.4.1 Recommended actions for improving maintenance performances

In both Project Scenarios, to improve the wagon maintenance performance and make the whole wagon maintenance process more efficient and cost-effective, the following actions are recommended, to be implemented in a period estimated from three to five years time.

- To improve the maintenance costs accounting system, implementing the emission of a work order for the interventions on each wagon. In the work order should be indicated:

- the list and the synthetic description of scheduled and non-scheduled works carried on
- the amount of direct man-hours necessary for each operation
- the list of the spare parts utilised for the maintenance intervention on the individual wagon

The system could start as a pilot application for one type of wagon and then extended to all the wagons and subassemblies maintained and repaired in the workshop.

Once the system is considered ready for a wider implementation it could be loaded on a computer based in the workshop

- To implement an internal system for the registration of technical data on the main maintenance activities (measures of wagon frame, measures of bogie frame, measures of wheelsets, measures of springs, test reports, etc..) so as to be able to assign responsibilities for the most relevant tasks, to have a traceability of the maintenance works and a relevant data base for maintenance activities.

Also in this case the system could start as a pilot application for bogie frames and then extended to all the wagon frames and main subassemblies maintained and repaired in the workshop.

Once the system is considered ready for a wider implementation it could be again loaded on a computer based in the workshop

- To organise training courses for technical people to make them more familiar with the accounting system and the whole wagon maintenance process, especially for those activities presently not carried on in Tajikistan. If necessary such course could be held in Moscow or in other countries in which is present the necessary know-how.

- To organise a centralized technical task force dedicated to identify and review the scheduled maintenance rules, with the aim of:

- carrying on a data collection, overview and critical examination of the existing rules and procedures for wagon maintenance and parts replacement.
- reducing redundant and un-necessary operations and proposing measures to extend preventive maintenance intervals, also with the adoption of technical modification and upgrade of wagon equipment (i.e. replacement of wheels or axle-bearings or brake components with more modern design or better operational performances)
- proposing revised technical criteria for the acceptability of repaired wagons and for the recover and repair of parts from scrapped wagons (i.e. wheelsets, brake components, coupling equipment, bogie frame, springs, etc.)

- indicating performance targets and revised technical specifications for the purchase of new wagons and new spare parts for the existing fleet, so to improve cost effectiveness and fleet reliability

7.1.2.4.2 Recommended actions for spare parts

For what concerns spare parts for wagon refurbishment, conversion and maintenance, three actions can be recommended aimed at reducing the purchase of all new parts abroad and stimulating the national capacity and industrial skill.

Recover and Repair

This action is aimed to re-define technical criteria for the repair and re-utilisation of parts recovered by the demolition of old or no more necessary types of wagons.

It could start with a critical examination of the existing criteria according to CIS rules and a re-definition of acceptance criteria and repair actions which should take into account modern repairing techniques, such as controlled atmosphere welding, metal spray, liquid nitrogen bushes replacement, etc.

Purchase in the domestic market

For a number of spare parts necessary for wagon maintenance it is not required an high level of industrial equipment and specialisation.

We refer for instance to welded, machined and forged mechanical components for which technical documents such as drawings and specifications are available.

A list of these parts should be prepared by railway engineers and for them tenders could be issued on a national basis to individuate and qualify as suppliers small or medium size companies able to produce such parts.

This process will be obviously not immediate, but also in the case that it should require one or two years, it will be able to generate the possibility of the creation of a national sector of spare parts suppliers for wagons and possibly also for other types of rolling stock.

The process could start with the following steps:

- Selection of the items and parts necessary for wagon maintenance for which it is estimated as existing a national capability to produce
- Collection of relevant technical documents for these components (or as a start for a part of them)
- Selection of possible partners in Tagikistan having the skill and technical competence and equipment
- Emission of orders for prototypes or small series to the possible suppliers, identified as above
- Assistance and collaboration with the suppliers for the production stages
- Testing of first products, also in operative service
- Follow-up and improvement of the process

Purchase in the international market

All the parts which cannot be recovered in a sufficient quantity and cannot be purchased in the national market should be included by TDZ railway engineers in a list of parts only available on the international market.

In this case it will be necessary to identify the possible suppliers and discuss with them the best conditions for the purchase.

It could be also considered the possibility of purchase in the CSI market second hand components to be restored in the TDZ wagon main workshop.

In case of need for small quantities it could be also possible to define agreements with other national railway companies based in the Central Asia region for common purchases or spare parts exchanges.

7.2 COST ESTIMATES

Capital costs

For each Project scenario the following capital costs have been considered and duly estimated:

- costs for the renewal of the wagon fleet (purchase, life-extension and conversion of wagons)
- costs for the rehabilitation of the workshops

Capital costs relevant to the renewal of the wagon fleet are based on the following average unitary estimates:

Table 26.- Rolling stock unitary investments costs - (monetary values are expressed in USD at 2005 prices)

Cost of a new wagon (USD)	70.000
Cost of a life-extension (USD)	21.000
Cost of a conversion (USD)	28.000
Extra life time of a life-extension (years)	10

The purchasing cost of a new wagon has been estimated on the basis of an average international CIF price of a 4-axle vehicle with 50-60 tons capacity.

The wagon life-extension and conversion costs have been calculated as shown in tables 27 and 28.

Table 27.- Estimate of an average wagon life-extension cost (monetary values are expressed in USD at 2005 prices)

Cost of spare parts	Wheelsets complete with axleboxes	8.600	USD
	Complete brake system	7.700	USD
	Coupling equipment	2.150	USD
	Mechanical parts (springs, stirrups, silentblocs, etc.)	550	USD
	Metal sheets and profiles, wood, paint	1.300	USD
	Other materials and parts	220	USD
Total Spare parts		20520	USD
Cost of Man power		480	USD
Total Costs		21.000	USD

Table 28.-Estimate of an average wagon conversion cost (monetary values are expressed in USD at 2005 prices)

Cost of spare parts	Wheel sets complete with axle boxes	8.600	USD
	Complete brake system	7.700	USD
	Coupling equipment	2.150	USD
	Mechanical parts (springs, stirrups, silent blocs, etc.)	550	USD
	Metal sheets and profiles, wood, paint	1.300	USD
	Materials and parts necessary for the reconstruction of siding walls or roof or other parts, depending on the type of conversion to be carried on	7.100	USD
Total Spare parts		27.400	USD
Cost of Man power		600	USD
Total Costs		28.000	USD

The costs of workshop refurbishment have been estimated by valuing separately :

- ✓ necessary equipment needed for carrying out the required ordinary and extraordinary maintenance works compliant with the relevant fleet renewal strategy.
- ✓ building works

A detailed description of workshop equipment costs for each Scenario is reported in tables 29 –34

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Table 29.-Scenario A – Equipment investment costs for Dushanbe workshop

Z	Description	unit	quantity	unitary price (US \$)	TOTAL (US \$)
1	Supply of steel work-top with drawers, dimensions 2000x700x860(H)	n°	2	672	1.344
2	Supply of drilling machine	n°	1	3.000	3.000
3	Supply of electro-hydraulic press	n°	1	5.400	5.400
4	Supply of metal plasma cutting machine	n°	1	3.960	3.960
5	Supply of welding machines MIG MAG	n°	2	3.480	6.960
8	Compressed air supply network:supply and installation of compressed-air plants composed by 2 Air compressors, air dryer and storage stainless steel tank .	n°	1	67.200	67.200
14	Supply of movable vacuum cleaner	n°	1	13.440	13.440
16	Supply of hot water pressure hydrocleaner	n°	2	5.400	10.800
18	Supply of mettalic ladders on wheels	n°	2	588	1.176
24	Brake Test Trolley: supply of trolleys for wagon brake equipment test with data recorder and paper printer	n°	1	14.400	14.400
26	Supply of steel cabinet with composable shelf	n°	8	1.320	10.560
27	Supply and installation of metal shelves for pallets and drawers provided with hand pallet-truck for stacking of spare stock in the Cental Store	n°	4	1.920	7.680
28	Supply of desk with PC and printer	n°	1	2.880	2.880
29	Supply of steel cabinet as tools container	n°	2	720	1.440
31	Supply of reprofiler	n°	2	1.440	2.880
36	Trans Pallet Trolley:supply of electrohydraulic Lifters - Liting power 2T (hand pallet-truck with rechargeable battery)	n°	1	672	672
37	Supply of pressure hydrosander	n°	1	5.400	5.400
41	Portable pneumatic tools	series	1	24.000	24.000
42	Various portable tools	series	1	12.000	12.000
43	Measuring instruments	series	1	12.000	12.000
44	Gauges, reference jigs and special tools	series	1	6.000	6.000
				Total	213.192,00

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Table 30.-Scenario A – Equipment investment costs for Kurgan Tyube workshop

z	Description	unit	quantity	unitary price (US \$)	TOTAL (US \$)
1	Supply of steel work-top with drawers, dimensions 2000x700x860(H)	n°	2	672	1.344
2	Supply of drilling machine	n°	1	3.000	3.000
3	Supply of electro-hydraulic press	n°	1	5.400	5.400
4	Supply of metal plasma cutting machine	n°	1	3.960	3.960
5	Supply of welding machines MIG MAG	n°	2	3.480	6.960
7	Supply and installation of equipment for alcalin batteries chargers of fork-lifts, with equipped desks, hydrogen detector, extractor of air and current rectifier.	n°	1	310.800	310.800
8	Compressed air supply network:supply and installation of compressed-air plants composed by 2 Air compressors, air dryer and storage stainless steel tank .	n°	1	67.200	67.200
9	Lifting Jacks: supply and installation of mobile wagon lift equipment mounted on rubber tyres, complete with control unit for simultaneous lifting. Lifting power 20 T each	n°	1	168.000	168.000
12	Fork Lift trucks: supply of fork-lifts including battery charger for spare parts workshop internal transport Lifting power 5T	n°	1	50.400	50.400
14	Supply of movable vacuum cleaner	n°	1	13.440	13.440
16	Supply of hot water pressure hydrocleaner	n°	2	5.400	10.800
18	Supply of mettalic ladders on wheels	n°	2	588	1.176
24	Brake Test Trolley: supply of trolleys for wagon brake equipment test with data recorder and paper printer	n°	1	14.400	14.400
26	Supply of steel cabinet with composable shelf	n°	8	1.320	10.560
27	Supply and installation of metal shelves for pallets and drawers provided with hand pallet-truck for stacking of spare stock in the Cental Store	n°	4	1.920	7.680
28	Supply of desk with PC and printer	n°	1	2.880	2.880
29	Supply of steel cabinet as tools container	n°	2	720	1.440
31	Supply of reprofiler	n°	2	1.440	2.880
35	Electric Tractors:supply of electrical tractors with batteries charger for the transportation of staff and materials	n°	1	672	672
37	Supply of pressure hydrosander	n°	1	5.400	5.400
41	Portable pneumatic tools	n° of series	1	24.000	24.000
42	Various portable tools	n° of series	1	12.000	12.000
43	Measuring instruments	n° of series	1	12.000	12.000
44	Gauges, reference jigs and special tools	n° of series	1	6.000	6.000
				Total	742.392

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Table 31.-Scenario A – Equipment investment costs for Makhram workshop

ZI	Description	unit	quantity	unitary price (US \$)	TOTAL (US \$)
1	Supply of steel work-top with drawers, dimensions 2000x700x860(H)	n°	6	672	4.032
2	Supply of drilling machine	n°	5	3.000	15.000
3	Supply of electro-hydraulic press	n°	1	5.400	5.400
4	Supply of metal plasma cutting machine	n°	2	3.960	7.920
5	Supply of welding machines MIG MAG	n°	3	3.480	10.440
6	Fixed beam Pressing Portal: supply and installation of a pressing portal structure for the final testing under load of the bogies of the wagons under overhaul in the workshop	n°	1	504.000	504.000
7	Supply and installation of equipment for alcalin batteries chargers of fork-lifts, with equipped desks, hydrogen detector, extractor of air and current rectifier.	n°	1	310.800	310.800
8	Compressed air supply network:supply and installation of compressed-air plants composed by 2 Air compressors, air dryer and storage stainless steel tank .	n°	1	67.200	67.200
9	Lifting Jacks: supply and installation of mobile wagon lift equipment mounted on rubber tyres, complete with control unit for simultaneous lifting. Lifting power 20 T each	n°	2	168.000	336.000
10	Supply of electric double beam overhead travelling crane - Lifting power 20T	n°	2	214.800	429.600
11	Column jib crane with electric chain host :supply and installation of a jib-crane for mechanical parts handling Lifting Power 1T	n°	2	63.840	127.680
12	Fork Lift trucks: supply of fork-lifts including battery charger for spare parts workshop internal transport Lifting power 5T	n°	3	50.400	151.200
13	Electronic Tinting machine: Supply of electronic machine for paint preparation with basic paint and different pulp colour	n°	1	8.280	8.280
14	Supply of movable vacuum cleaner	n°	3	13.440	40.320
15	Loose part washing and blowing system:supply of automatic washing machine for components of mechanical parts	n°	3	1.260	3.780
16	Supply of hot water pressure hydrocleaner	n°	5	5.400	27.000
17	Supply of bending press	n°	1	55.920	55.920
18	Supply of mettalic ladders on wheels	n°	4	588	2.352
19	Supply of hacksaw with continuous belt	n°	1	2.520	2.520
20	helicoidal springs machine testing :supply of automatic machines for the coil-springs' elasticity test for the suspension of the bogies' wagon under overhaul	n°	1	57.120	57.120
21	Supply and installation of painting cabin for disassembled items	n°	1	36.240	36.240
22	Pressing machine for dampers testing:supply of oleodynamic machine for the control of dampers' mechanical characteristic	n°	1	70.560	70.560
23	Calander: supply of bending and curving machine for metal sheets	n°	1	33.000	33.000
24	Brake Test Trolley: supply of trolleys for wagon brake equipment test with data recorder and paper printer	n°	3	14.400	43.200
25	Equipment for fault diagnosis and non destructive controls on bearings and axleboxes	n°	2	28.800	57.600
26	Supply of steel cabinet with composable shelf	n°	45	1.320	59.400
27	Supply and installation of metal shelves for pallets and drawers provided with hand pallet-truck for stacking of spare stock in the Cental Store	n°	60	1.920	115.200
28	Supply of desk with PC and printer	n°	2	2.880	5.760
29	Supply of steel cabinet as tools container	n°	11	720	7.920
30	Supply of universal milling machine	n°	1	90.000	90.000
31	Supply of reprofiler	n°	4	1.440	5.760
32	Bogie washing tunnel:supply and installation of a washing machine with pressured water for complete bogies and wheelsets	n°	1	180.000	180.000
33	Plates shear: supply of metal sheets cutting machine	n°	1	65.640	65.640
34	Supply of puncher machine	n°	2	33.360	66.720

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35	Electric Tractors:supply of electrical tractors with batteries charger for the transportation of staff and materials	n°	2	21.840	43.680
36	Trans Pallet Trolley:supply of electrohydraulic Lifters - Liting power 2T (hand pallet-truck with rechargeable battery)	n°	3	672	2.016
37	Supply of pressure hydrosander	n°	3	5.400	16.200
38	Supply of parallel lathe	n°	1	58.440	58.440
39	Measuring bed for bogie frames of the wagons under overhaul	n°	1	43.680	43.680
40	Welding benches with welding-machine, smokes aspiration, hoist, work-top and accessories	n°	1	48.000	48.000
41	Portable pneumatic tools	series	1	144.000	144.000
42	Various portable tools	series	1	108.000	108.000
43	Measuring instruments	series	1	36.000	36.000
44	Gauges, reference jigs and special tools	series	1	24.000	24.000
45	Equipment for test and repair of brake system components	series	1	144.000	144.000
				Total	3.671.580

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Table 32.-Scenario B – Equipment investment costs for Dushanbe workshop

z	Description	unit	quantity	unitary price (US \$)	TOTAL (US \$)
1	Supply of steel work-top with drawers, dimensions 2000x700x860(H)	n°	2	672	1.344
2	Supply of drilling machine	n°	1	3.000	3.000
3	Supply of electro-hydraulic press	n°	1	5.400	5.400
4	Supply of metal plasma cutting machine	n°	1	3.960	3.960
5	Supply of welding machines MIG MAG	n°	2	3.480	6.960
8	Compressed air supply network:supply and installation of compressed-air plants composed by 2 Air compressors, air dryer and storage stainless steel tank .	n°	1	67.200	67.200
14	Supply of movable vacuum cleaner	n°	1	13.440	13.440
16	Supply of hot water pressure hydrocleaner	n°	2	5.400	10.800
18	Supply of mettalic ladders on wheels	n°	2	588	1.176
24	Brake Test Trolley: supply of trolleys for wagon brake equipment test with data recorder and paper printer	n°	1	14.400	14.400
26	Supply of steel cabinet with composable shelf	n°	8	1.320	10.560
27	Supply and installation of metal shelves for pallets and drawers provided with hand pallet-truck for stacking of spare stock in the Cental Store	n°	4	1.920	7.680
28	Supply of desk with PC and printer	n°	1	2.880	2.880
29	Supply of steel cabinet as tools container	n°	2	720	1.440
31	Supply of reprofiler	n°	2	1.440	2.880
36	Trans Pallet Trolley:supply of electrohydraulic Lifters - Liting power 2T (hand pallet-truck with rechargeable battery)	n°	1	672	672
37	Supply of pressure hydrosander	n°	1	5.400	5.400
41	Portable pneumatic tools	series	1	24.000	24.000
42	Various portable tools	series	1	12.000	12.000
43	Measuring instruments	series	1	12.000	12.000
44	Gauges, reference jigs and special tools	series	1	6.000	6.000
				Total	213.192,00

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Table 33.-Scenario B – Equipment investment costs for Kurgan Tyube workshop

Z	Description	unit	quantity	unitary price (US \$)	TOTAL (US \$)
1	Supply of steel work-top with drawers, dimensions 2000x700x860(H)	n°	2	672	1.344
2	Supply of drilling machine	n°	1	3.000	3.000
3	Supply of electro-hydraulic press	n°	1	5.400	5.400
4	Supply of metal plasma cutting machine	n°	1	3.960	3.960
5	Supply of welding machines MIG MAG	n°	2	3.480	6.960
7	Supply and installation of equipment for alcalin batteries chargers of fork-lifts, with equipped desks, hydrogen detector, extractor of air and current rectifier.	n°	1	310.800	310.800
8	Compressed air supply network: supply and installation of compressed-air plants composed by 2 Air compressors, air dryer and storage stainless steel tank .	n°	1	67.200	67.200
9	Lifting Jacks: supply and installation of mobile wagon lift equipment mounted on rubber tyres, complete with control unit for simultaneous lifting. Lifting power 20 T each	n°	1	168.000	168.000
12	Fork Lift trucks: supply of fork-lifts including battery charger for spare parts workshop internal transport Lifting power 5T	n°	1	50.400	50.400
14	Supply of movable vacuum cleaner	n°	1	13.440	13.440
16	Supply of hot water pressure hydrocleaner	n°	2	5.400	10.800
18	Supply of mettalic ladders on wheels	n°	2	588	1.176
24	Brake Test Trolley: supply of trolleys for wagon brake equipment test with data recorder and paper printer	n°	1	14.400	14.400
26	Supply of steel cabinet with composable shelf	n°	8	1.320	10.560
27	Supply and installation of metal shelves for pallets and drawers provided with hand pallet-truck for stacking of spare stock in the Cental Store	n°	4	1.920	7.680
28	Supply of desk with PC and printer	n°	1	2.880	2.880
29	Supply of steel cabinet as tools container	n°	2	720	1.440
31	Supply of reprofiler	n°	2	1.440	2.880
35	Electric Tractors: supply of electrical tractors with batteries charger for the transportation of staff and materials	n°	1	672	672
37	Supply of pressure hydrosander	n°	1	5.400	5.400
41	Portable pneumatic tools	n° of series	1	24.000	24.000
42	Various portable tools	n° of series	1	12.000	12.000
43	Measuring instruments	n° of series	1	12.000	12.000
44	Gauges, reference jigs and special tools	n° of series	1	6.000	6.000
				Total	742.392

Table 34.-Scenario B – Equipment investment costs for Makhram workshop

z:	Description	unit	quantity	unitary price (US \$)	TOTAL (US \$)
1	Supply of steel work-top with drawers, dimensions 2000x700x860(H)	n°	4	672	2.688
2	Supply of drilling machine	n°	4	3.000	12.000
3	Supply of electro-hydraulic press	n°	1	5.400	5.400
4	Supply of metal plasma cutting machine	n°	2	3.960	7.920
5	Supply of welding machines MIG MAG	n°	3	3.480	10.440
6	Fixed beam Pressing Portal: supply and installation of a pressing portal structure for the final testing under load of the bogies of the wagons under overhaul in the workshop	n°	1	504.000	504.000
7	Supply and installation of equipment for alcalin batteries chargers of fork-lifts, with equipped desks, hydrogen detector, extractor of air and current rectifier.	n°	1	310.800	310.800
8	Compressed air supply network:supply and installation of compressed-air plants composed by 2 Air compressors, air dryer and storage stainless steel tank .	n°	1	67.200	67.200
9	Lifting Jacks: supply and installation of mobile wagon lift equipment mounted on rubber tyres, complete with control unit for simultaneous lifting. Lifting power 20 T each	n°	2	168.000	336.000
10	Supply of electric double beam overhead travelling crane - Lifting power 20T	n°	2	214.800	429.600
11	Column jib crane with electric chain host :supply and installation of a jib-crane for mechanical parts handling Lifting Power 1T	n°	2	63.840	127.680
12	Fork Lift trucks: supply of fork-lifts including battery charger for spare parts workshop internal transport Lifting power 5T	n°	3	50.400	151.200
13	Electronic Tinting machine: Supply of electronic machine for paint preparation with basic paint and different pulp colour	n°	1	8.280	8.280
14	Supply of movable vacuum cleaner	n°	3	13.440	40.320
15	Loose part washing and blowing system:supply of automatic washing machine for components of mechanical parts	n°	3	1.260	3.780
16	Supply of hot water pressure hydrocleaner	n°	5	5.400	27.000
17	Supply of bending press	n°	1	55.920	55.920
18	Supply of mettalic ladders on wheels	n°	4	588	2.352
19	Supply of hacksaw with continuous belt	n°	1	2.520	2.520
20	helicoidal springs machine testing :supply of automatic machines for the coil-springs' elasticity test for the suspension of the bogies' wagon under overhaul	n°	1	57.120	57.120
21	Supply and installation of painting cabin for disassembled items	n°	1	36.240	36.240
22	Pressing machine for dampers testing:supply of oleodynamic machine for the control of dampers' mechanical characteristic	n°	1	70.560	70.560
24	Brake Test Trolley: supply of trolleys for wagon brake equipment test with data recorder and paper printer	n°	3	14.400	43.200
25	Equipment for fault diagnosis and non destructive controls on bearings and axleboxes	n°	2	28.800	57.600
26	Supply of steel cabinet with composable shelf	n°	35	1.320	46.200
27	Supply and installation of metal shelves for pallets and drawers provided with hand pallet-truck for stacking of spare stock in the Cental Store	n°	40	1.920	76.800
28	Supply of desk with PC and printer	n°	2	2.880	5.760
29	Supply of steel cabinet as tools container	n°	8	720	5.760
30	Supply of universal milling machine	n°	1	90.000	90.000
31	Supply of reprofiler	n°	4	1.440	5.760
32	Bogie washing tunnel:supply and installation of a washing machine with pressured water for complete bogies and wheelsets	n°	1	180.000	180.000
33	Plates shear: supply of metal sheets cutting machine	n°	1	65.640	65.640
35	Electric Tractors:supply of electrical tractors with batteries charger for the transportation of staff and materials	n°	2	21.840	43.680
36	Trans Pallet Trolley:supply of electrohydraulic Lifters - Liting power 2T (hand pallet-truck with rechargeable battery)	n°	3	672	2.016
37	Supply of pressure hydrosander	n°	3	5.400	16.200
38	Supply of parallel lathe	n°	1	58.440	58.440
39	Measuring bed for bogie frames of the wagons under overhaul	n°	1	43.680	43.680

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40	Welding benches with welding-machine, smokes aspiration, hoist, work-top and accessories	n°	1	48.000	48.000
41	Portable pneumatic tools	series	1	108.000	108.000
42	Various portable tools	series	1	84.000	84.000
43	Measuring instruments	series	1	24.000	24.000
44	Gauges, reference jigs and special tools	series	1	14.400	14.400
45	Equipment for test and repair of brake system components	series	1	144.000	144.000
				Total	3.432.156

Capital costs for building works, which are common to both scenarios, include:

Makhrum

- preparation of foundations for the new equipment requiring works on the ground (washing machines, press for bogies, painting cabin, cranes, etc.)
- refurbishment and levelling of parts of the industrial floor in line with the lay-out re-arrangement and the position of the new equipment
- general repair of civil structures
- refurbishment of some sections of the lighting and electric power system
- installation of electrical wiring for power supply to the new equipment
- installation of water pipes for washing machines

A total cost of 0,55 Million of USD has been estimated.

Kurgan-Tube

- Civil works for the completion of the facility (considering the multi-task vocation of the facility, only 20% of total estimated costs have been allocated to the Project).

The Consultant's estimate is 0,2 Million of USD.

Dushanbe

- refurbishment and levelling of parts of the industrial floor in line with the lay-out re-arrangement, the position of the new equipment and the elimination of old equipment to be eliminated or sent to other workshops
- refurbishment of some small sections of the lighting and electric power system
- installation of electrical wiring for power supply to the new equipment
- general repair of civil structures

The estimate for those works is 0,01 Million of USD.

The total investment cost of each Project option is reported in the following tables:

Table 35.- Scenario A – Investment cost estimate (Mill.USD at 2005 prices)

Rolling stock - investment cost estimate (USD at 2005 prices) Scenario A			
	Foreign costs	Local costs	Total costs
Purchased of new wagons	83.943.263	-	83.943.263
Conversion of freight wagons	12.402.880	253.120	12.656.000
Refurbishment of freight wagons	11.590.656	236.544	11.827.200
Workshop rehabilitation	-	760.000	760.000
Purchase of workshop equipment	4.627.164	-	4.627.164
TOTAL	112.563.963	1.249.664	113.813.627

Table 36.- Scenario B – Investment cost estimate (Mill.USD at 2005 prices)

Rolling stock - investment cost estimate (USD at 2005 prices) Scenario B			
	Foreign costs	Local costs	Total costs
Purchased of new wagons	109.633.263	-	109.633.263
Conversion of freight wagons	-	-	-
Refurbishment of freight wagons	-	-	-
Workshop rehabilitation	-	730.000	730.000
Purchase of workshop equipment	4.387.740	-	4.387.740
TOTAL	114.021.003	730.000	114.751.003

Here following the envisaged time distribution of estimated investment costs is described:

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Table 37.- Scenario A – Total investments costs by year

	Investment cost					
	Wagon				Workshop	
	New	Converted	Refurbishment	Scrapped	Costruction	Equipment
2006	0,00	0,00	0,00	-0,07	0,76	4,00
2007	0,00	3,16	0,54	-0,07	0,00	0,62
2008	0,00	3,16	0,54	-0,07	0,00	0,00
2009	0,00	3,16	0,54	-0,07	0,00	0,00
2010	0,00	3,16	0,54	-0,07	0,00	0,00
2011	4,85	0,00	0,52	-0,02	0,00	0,00
2012	4,85	0,00	0,52	-0,02	0,00	0,00
2013	4,85	0,00	0,52	-0,02	0,00	0,00
2014	4,85	0,00	0,52	-0,02	0,00	0,00
2015	4,85	0,00	0,52	-0,02	0,00	0,00
2016	4,60	0,00	0,98	-0,04	0,00	0,00
2017	4,60	0,00	0,98	-0,04	0,00	0,00
2018	4,60	0,00	0,98	-0,04	0,00	0,00
2019	4,60	0,00	0,98	-0,04	0,00	0,00
2020	4,60	0,00	0,98	-0,04	0,00	0,00
2021	7,34	0,00	0,43	-0,05	0,00	0,00
2022	7,34	0,00	0,43	-0,05	0,00	0,00
2023	7,34	0,00	0,43	-0,05	0,00	0,00
2024	7,34	0,00	0,43	-0,05	0,00	0,00
2025	7,34	0,00	0,43	-0,05	0,00	0,00

Table 38.- Scenario B – Total investments costs by year

	Investment cost					
	Wagon				Workshop	
	New	Converted	Refurbishment	Scrapped	Costruction	Equipment
2006	0,00	0,00	0,00	-0,13	0,73	4,00
2007	9,50	0,00	0,00	-0,13	0,00	0,38
2008	9,50	0,00	0,00	-0,13	0,00	0,00
2009	9,50	0,00	0,00	-0,13	0,00	0,00
2010	9,50	0,00	0,00	-0,13	0,00	0,00
2011	5,60	0,00	0,00	-0,04	0,00	0,00
2012	5,60	0,00	0,00	-0,04	0,00	0,00
2013	5,60	0,00	0,00	-0,04	0,00	0,00
2014	5,60	0,00	0,00	-0,04	0,00	0,00
2015	5,60	0,00	0,00	-0,04	0,00	0,00
2016	5,57	0,00	0,00	-0,04	0,00	0,00
2017	5,57	0,00	0,00	-0,04	0,00	0,00
2018	5,57	0,00	0,00	-0,04	0,00	0,00
2019	5,57	0,00	0,00	-0,04	0,00	0,00
2020	5,57	0,00	0,00	-0,04	0,00	0,00
2021	3,16	0,00	0,00	-0,01	0,00	0,00
2022	3,16	0,00	0,00	-0,01	0,00	0,00
2023	3,16	0,00	0,00	-0,01	0,00	0,00
2024	3,16	0,00	0,00	-0,01	0,00	0,00
2025	3,16	0,00	0,00	-0,01	0,00	0,00

Operating costs

As stated in § 7.1.2, the renewal of the wagon fleet will imply changes in the organisation of the maintenance process, with corresponding impact in terms of costs.

Project Option A will involve, according to the estimates reported in § 7.1.3, significant increase in the work load of existing workshops, needed to meet the demand for wagon refurbishment/conversion and for future wagon stock maintenance.

Under Project Option B, improvements in the maintenance organisation and equipment will enable Tajik Railways to cope more efficiently with the future capital repair requirements of the wagon fleet, reducing the number of breakdown and therefore contributing to lower staff required per unit.

The following assumptions have been adopted for the forecast of maintenance costs in the two Scenarios:

Table 39.- Scenario A – Average use of inputs in the wagon maintenance process
(values per wagon)

	Scenario A	
	Man Hours	Spare Parts (US \$)
Heavy Capital repair	300	2160
Light capital repair	180	900
Depot+ running maintenance	80	190

Table 40.- Scenario B – –Average use of inputs in the wagon maintenance process
(values per wagon)

	Scenario B	
	Man Hours	Spare Parts (US \$)
Heavy Capital repair	300	2016
Light capital repair	180	840
Depot+ running maintenance	80	190

The cost of labour have been calculated on the base of the following hourly cost:

Table 41.- Estimate of hourly labour cost

Average monthly salary (Somon)	Social Insurance and bonuses (Somon)	Workshop overheads (Somon)	Total monthly cost (Somon)	Hourly cost (Somon)	Hourly cost (USD 2005)
150	93	73	317	2,0	0,66

The overall operating costs have been estimated by multiplying these unit costs by the number of relevant production units.

It is to be noted that the above mentioned parameters have been assumed on the basis of international best practise, cross-checked with operational parameters typical of other TRACECA countries, as resulting from previous TACIS studies.

The comparison with current maintenance costs has deserved particular attention due to :

- the lack of an adequate cost accounting system
- the disruptions to normal maintenance practices caused by foreign currency shortage which involve the cannibalisation of surplus wagon rather than the use of new spare parts
- the difficulty of estimating the cost of maintenance activities presently not carried out (Major Overhaul) due to lack of adequate equipment and therefore outsourced to neighbouring countries.

In the latter case, a reconstruction of the real value of consumed resources during the maintenance process has been carried out by the Consultant.

7.3 FINANCIAL AND ECONOMIC ASSESSMENT

In order to evaluate the financial and economic sustainability of each Project Scenario, a standard approach based on a comparative quantification of the costs and revenues (benefits) between a "Without Project" scenario and the two "With Project" scenarios has been adopted.

Costs and revenues (benefits) have been valued along an appraisal period of 20 years, considered to be appropriate for the average economically useful life of the assets involved in the Projects. Among the revenue (benefit) items at the final year, a residual value of the assets has been computed.

As a measure of financial and economic feasibility, traditional indicators such as NPV (Net Present Value) and IRR (Internal Rate of Return) have been utilised.

It is worth mentioning that, given the nature of the project, the financial and economic assessment resulted to be much closer to a least-cost analysis than a traditional cost-revenues (benefit) evaluation. This because, in the present case, the two Project alternatives are expected to deliver the same benefits compared to the "Without Project" option, since they represent alternative ways of producing the same output (a target wagon fleet with a given size and composition) to meet forecast demand.

As a consequence, the choice of the most desirable Scenario has been basically driven by the ability of each mutually exclusive alternative to supply the target output with the lowest present value of costs.

7.3.1 "Without Project Scenario"

The "Without Project" scenario has been based on a realistic assumption of what would happen should the Projects not be implemented.

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It envisages that no investments in rolling stock and workshop equipment will occur and no changes in the current maintenance strategies will take place.

In this scenario, it has been assumed that Tajik railways will keep on operating the present wagon fleet until it reaches the end of its working life, according to the progressive ageing. In order to meet the transport demand for export and domestic services, Tajik railways will put forward two kind of actions:

- continuing the present policy of converting a minimum part of existing wagons not suitable to market requirements, in accordance with technical/technological constraints. This policy will apply in particular only to those refrigerated wagons which are supposed to be in good conditions and therefore eligible to easier conversion processes;
- resorting heavily on hired wagons, with a corresponding increased burden on public finances.

For what concerns wagon maintenance, the following assumptions have been made:

- Heavy capital maintenance.

Given the lack of spare parts and the unavailability of adequate equipment it is presumable that Tajik railways will continue the present policy to externalise all capital repair (KR) operations to other CIS countries (Uzbekistan) fitted with necessary capabilities. The relevant cost has been calculated based on an average CIS market cost as resulting from previous TRACECA studies, increased by a 100% of profit margins)

- Running, depot and light capital maintenance.
- These activities have been valued according to data provided by Tajik Railways. In the case of light capital repair, relevant costs clearly reflect a situation where foreign currency shortage leads to the cannibalisation of surplus wagon rather than the use of new spare parts.

The following table summarises the operating costs associated to the "Without" Project Scenario.

Table 42.- Cost of the scenario "without project"

	Investment cost						Operating cost			Total cost
	Wagon				Workshop		Wagon		Workshop	
	New	Refurbishment	Extended	Scrapped	Costruction	Equipment	Hire	Maintenance	Maintenance	
2006	0,00	0,00	0,00	-0,09	0,00	0,00	3,72	2,18	0,05	5,86
2007	0,00	0,27	0,00	-0,09	0,00	0,00	3,72	1,98	0,05	5,93
2008	0,00	0,27	0,00	-0,09	0,00	0,00	3,72	1,80	0,05	5,75
2009	0,00	0,27	0,00	-0,09	0,00	0,00	3,72	1,62	0,05	5,57
2010	0,00	0,27	0,00	-0,09	0,00	0,00	3,72	1,43	0,05	5,38
2011	0,00	0,00	0,00	-0,07	0,00	0,00	4,41	1,30	0,05	5,69
2012	0,00	0,00	0,00	-0,07	0,00	0,00	5,10	1,16	0,05	6,24
2013	0,00	0,00	0,00	-0,07	0,00	0,00	5,79	1,01	0,05	6,78
2014	0,00	0,00	0,00	-0,07	0,00	0,00	6,48	0,87	0,05	7,32
2015	0,00	0,00	0,00	-0,07	0,00	0,00	7,17	0,72	0,05	7,87
2016	0,00	0,00	0,00	-0,05	0,00	0,00	7,93	0,62	0,05	8,55
2017	0,00	0,00	0,00	-0,05	0,00	0,00	8,69	0,51	0,05	9,20
2018	0,00	0,00	0,00	-0,05	0,00	0,00	9,45	0,41	0,05	9,86
2019	0,00	0,00	0,00	-0,05	0,00	0,00	10,21	0,30	0,05	10,51
2020	0,00	0,00	0,00	-0,05	0,00	0,00	10,97	0,20	0,05	11,17
2021	0,00	0,00	0,00	-0,01	0,00	0,00	11,40	0,17	0,05	11,61
2022	0,00	0,00	0,00	-0,01	0,00	0,00	11,82	0,15	0,05	12,00
2023	0,00	0,00	0,00	-0,01	0,00	0,00	12,24	0,12	0,05	12,40
2024	0,00	0,00	0,00	-0,01	0,00	0,00	12,67	0,09	0,05	12,80
2025	0,00	0,00	0,00	-0,01	0,00	0,00	13,09	0,05	0,05	13,18

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the freight wagon fleet of Tajik Railways***

It is to be mentioned that capital requirements of the Without Project scenario are partially reduced by the scrapping of surplus wagons which have exceeded the end of their useful life.

For what concerns the costs to be borne for wagon hire, no data on present relevant expenditures were provided by Tajik Railways. As a consequence, the Consultant has carried out his estimates on future expected wagon hire expenditures, assuming the following requirements of wagons to be hired on a yearly basis:

Table 43.- Yearly number of wagons to be hired in the scenario "without project"

Year	2010	2015	2020	2025
Number of wagons	394	759	1.162	1.386

It has been assumed that Tajik Railways will be charged on average 34,5 Swiss Francs/day per wagon by the Owner Railways, in accordance with CIS rules.

7.3.2 Financial assessment

The "With" and "Without" scenarios have been compared in the form of financial projections, showing forecast incremental costs and revenues at USD in constant prices 2005, with residual value of assets (if any) estimated as a financial benefit in the final project year.

The financial appraisal of the Project options has been performed on a commercial basis, that is, at market prices.

Based on the estimates reported in § 7.2 and 7.3, the net capital and operating costs of Project Options A and B are shown in table 44

Table 44.- Financial Analysis- Project option A Versus "without Project " Option
(Million USD at 2005 prices)

Project option A Versus "without Project " Option							
Years	Capital Costs		Operating Costs			Revenues	Total
	Wagon Fleet	Workshop	Wagon Hire	Wagon maintenance	Workshop maintenance	Scrapping of wagons	
2005	-	(4,77)	-	-	-	-	(4,77)
2006	-	(0,62)	-	-	0,05	(0,01)	(0,58)
2007	(3,44)	-	3,72	(0,00)	(0,15)	(0,01)	0,11
2008	(3,44)	-	3,72	(0,03)	(0,15)	(0,01)	0,09
2009	(3,44)	-	3,72	(0,05)	(0,15)	(0,01)	0,07
2010	(3,44)	-	3,72	(0,07)	(0,15)	(0,01)	0,05
2011	(5,37)	-	4,41	(0,42)	(0,15)	(0,05)	(1,58)
2012	(5,37)	-	5,10	(0,62)	(0,15)	(0,05)	(1,09)
2013	(5,37)	-	5,79	(0,82)	(0,15)	(0,05)	(0,60)
2014	(5,37)	-	6,48	(1,01)	(0,15)	(0,05)	(0,11)
2015	(5,37)	-	7,17	(1,21)	(0,15)	(0,05)	0,38
2016	(5,58)	-	7,93	(1,30)	(0,15)	(0,02)	0,88
2017	(5,58)	-	8,69	(1,43)	(0,15)	(0,02)	1,52
2018	(5,58)	-	9,45	(1,55)	(0,15)	(0,02)	2,16
2019	(5,58)	-	10,21	(1,67)	(0,15)	(0,02)	2,80
2020	(5,58)	-	10,97	(1,79)	(0,15)	(0,02)	3,44
2021	(7,77)	-	11,40	(1,90)	(0,15)	0,04	1,62
2022	(7,77)	-	11,82	(1,96)	(0,15)	0,04	1,97
2023	(7,77)	-	12,24	(2,03)	(0,15)	0,04	2,32
2024	(7,77)	-	12,67	(2,10)	(0,15)	0,04	2,68
2025	55,86	-	13,09	(2,19)	(0,15)	0,04	66,65
NPV					\$3,48	IRR	15%

Table 45.- Financial Analysis- Project option B Versus "without Project " Option
(Million USD at 2005 prices)

Project option B Versus "without Project " Option							
Years	Capital Costs		Operating Costs			Revenues	Total
	Wagon Fleet	Workshop	Wagon Hire	Wagon maintenance	Workshop maintenance	Scrapping of wagons	
2005	-	(4,73)	-	-	-	-	(4,73)
2006	-	(0,38)	-	-	0,05	0,04	(0,27)
2007	(9,23)	-	3,72	(0,04)	(0,15)	0,04	(5,65)
2008	(9,23)	-	3,72	(0,13)	(0,15)	0,04	(5,75)
2009	(9,23)	-	3,72	(0,22)	(0,15)	0,04	(5,84)
2010	(9,23)	-	3,72	(0,31)	(0,15)	0,04	(5,93)
2011	(5,60)	-	4,41	(0,46)	(0,15)	(0,03)	(1,83)
2012	(5,60)	-	5,10	(0,63)	(0,15)	(0,03)	(1,30)
2013	(5,60)	-	5,79	(0,79)	(0,15)	(0,03)	(0,78)
2014	(5,60)	-	6,48	(0,96)	(0,15)	(0,03)	(0,25)
2015	(5,60)	-	7,17	(1,12)	(0,15)	(0,03)	0,27
2016	(5,57)	-	7,93	(1,25)	(0,15)	(0,01)	0,95
2017	(5,57)	-	8,69	(1,37)	(0,15)	(0,01)	1,59
2018	(5,57)	-	9,45	(1,50)	(0,15)	(0,01)	2,22
2019	(5,57)	-	10,21	(1,63)	(0,15)	(0,01)	2,86
2020	(5,57)	-	10,97	(1,75)	(0,15)	(0,01)	3,49
2021	(3,16)	-	11,40	(1,82)	(0,15)	-	6,27
2022	(3,16)	-	11,82	(1,88)	(0,15)	-	6,63
2023	(3,16)	-	12,24	(1,94)	(0,15)	-	6,99
2024	(3,16)	-	12,67	(2,00)	(0,15)	-	7,35
2025	63,18	-	13,09	(2,08)	(0,15)	-	74,04
NPV					-\$7,71 IRR		9%

It is to be noted that, since no traffic generated by one Scenario against the other has been assumed, the comparison between the two Scenarios has focused on identifying the least cost option able to meet the future expected demand of wagons.

In this respect, the figures indicate that, although the investment costs of the two Scenarios are similar, their time distribution differs substantially with an anticipation of both capital and operating expenditures in Scenario B, placing in particular a large financial burden on the railways in the short term.

Scenario A shows therefore a higher NPV and, as a consequence, a more satisfactory IRR (15% against 9% of Scenario B).

7.3.3 Economic assessment

As already mentioned in § 2, Tajik railways transport large quantities of relatively bulky freight, such as aluminum and cotton. Road transport does not yet represent a valid alternative for these goods because of the poor state of the road system and the size, age and condition of the truck fleet. Consequently, any

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inefficiency in the management of the rail business will have an immediate and direct impact on the economic well-being of the country.

The primary benefit of the Project will consist in the reduction of the financial burden on state budget (and tax payers) resulting from the need of hiring a great amount of wagon from neighbouring countries. Avoiding such burden would allow the setting of capital free that might be used to further develop the rail system faster or be spent on other purposes. The Project will also allow to increase as much as possible operating efficiency and reduce, unitary maintenance costs of capital repair.

The assessment of the Project's economic sustainability has been carried out through the use of appropriate conversion factors for each of the financial inflow and outflow items, to take into account possible price distortion of the market.

- Tradable inputs were valued at international border prices
- Non tradable inputs were valued by deducting transfer payments from financial values. Financial labour costs were adjusted by applying a conversion factor of 0,6, reflecting the relative weight of indirect taxes and social costs.

Table 46.- Cost-Benefit Analysis- Project option A Versus "without Project " Option
(Million USD at 2005 prices)

Project option A Versus "without Project " Option					
Years	Economic Costs		Economic Benefits		Total
	Investment costs	Operating costs of wagons maintenance	Savings from wagon Hire	Savings from capital wagon maintenance	
2005	-	-	-		-
2006	(4,29)	(0,12)			(4,41)
2007	(4,02)	(0,91)	3,72	0,78	(0,42)
2008	(3,40)	(0,86)	3,72	0,71	0,18
2009	(3,40)	(0,80)	3,72	0,64	0,16
2010	(3,40)	(0,75)	3,72	0,57	0,14
2011	(5,37)	(1,03)	4,41	0,51	(1,48)
2012	(5,37)	(1,17)	5,10	0,46	(0,98)
2013	(5,37)	(1,30)	5,79	0,40	(0,48)
2014	(5,37)	(1,43)	6,48	0,34	0,02
2015	(5,37)	(1,56)	7,17	0,28	0,52
2016	(5,57)	(1,61)	7,93	0,24	1,00
2017	(5,57)	(1,68)	8,69	0,20	1,64
2018	(5,57)	(1,76)	9,45	0,16	2,29
2019	(5,57)	(1,83)	10,21	0,12	2,93
2020	(5,57)	(1,91)	10,97	0,08	3,58
2021	(7,77)	(2,00)	11,40	0,07	1,70
2022	(7,77)	(2,05)	11,82	0,06	2,06
2023	(7,77)	(2,11)	12,24	0,05	2,41
2024	(7,77)	(2,16)	12,67	0,04	2,77
2025	55,86	(2,23)	13,09	0,02	66,75
NPV		\$4,87 IRR		17%	

Table 47.- Cost-Benefit Analysis- Project option B Versus "without Project " Option
(Million USD at 2005 prices)

Project option B Versus "without Project " Option					
Years	Economic Costs		Economic Benefits		Total
	Investment costs	Operating costs of wagons maintenance	Savings from wagon Hire	Savings from capital wagon maintenance	
2005	-	-	-		-
2006	(4,28)	0,11			(4,17)
2007	(9,61)	(0,94)	3,72	0,78	(6,04)
2008	(9,25)	(0,96)	3,72	0,71	(5,77)
2009	(9,25)	(0,97)	3,72	0,64	(5,86)
2010	(9,25)	(0,99)	3,72	0,57	(5,95)
2011	(5,60)	(1,08)	4,41	0,51	(1,75)
2012	(5,60)	(1,18)	5,10	0,46	(1,22)
2013	(5,60)	(1,28)	5,79	0,40	(0,69)
2014	(5,60)	(1,38)	6,48	0,34	(0,15)
2015	(5,60)	(1,47)	7,17	0,28	0,38
2016	(5,57)	(1,55)	7,93	0,24	1,05
2017	(5,57)	(1,63)	8,69	0,20	1,69
2018	(5,57)	(1,71)	9,45	0,16	2,33
2019	(5,57)	(1,79)	10,21	0,12	2,97
2020	(5,57)	(1,87)	10,97	0,08	3,61
2021	(3,16)	(1,92)	11,40	0,07	6,38
2022	(3,16)	(1,97)	11,82	0,06	6,74
2023	(3,16)	(2,02)	12,24	0,05	7,11
2024	(3,16)	(2,07)	12,67	0,04	7,47
2025	63,18	(2,12)	13,09	0,02	74,16
NPV		-\$6,57		IRR	9%

In accordance with the results of the financial assessment, Project Scenario A results to be more attractive in economic terms, generating an IRR of 17% against a value of 9% in Project Scenario B.

NPV (discounted at a 12% rate) of scenario A is about 4,87 Million of USD, against scenario B a -6,57 Million of USD.

8 . CONCLUSIONS AND RECOMMENDATIONS

The results of the financial and economic appraisal indicate that the strategy of wagon fleet rationalisation based on a refurbishment programme of existing vehicles through the use of duly upgraded existing maintenance facilities (Scenario A) deserves higher priority over the strategy which involves substantial purchase in new vehicles (Scenario B).

Scenario A, in particular, results to be the least cost option in present value terms, allowing for an investment disbursement schedule more balanced along the time and avoiding hardly affordable outflows in the short-medium term. In addition, Scenario A permits to maximise the use of existing maintenance facilities, allowing for a more cost-effective use of the resources.

The long term capital cost requirement (to be spread over a 20 year's period) of Scenario A total around 107 Million USD.

Even if such large amount could achieve a worthwhile investment (se described in § 7.3.2 and 7.3.3), it seems unlikely that Tajikistan could easily cope with it over the next years.

Although in the most recent years Tajikistan experienced improved governance that led to better internal security and higher living standards, the long-term sustainability of growth is still uncertain.

According to ADB, in 2004 trade deficit widened due to the increase in imports associated with strong economic recovery, external debt amounted at 41.1% of GDP while debt service obligations accounted for 49,2% of exports.

To ensure long term external sustainability, the Government has adopted a policy that implies a maximum yearly disbursement for public investment, which is financed by external borrowing, not exceeding 3% of GDP. As result, the Government has decided not to contract any new debt that is not offered in concessional terms.

Also in the light of the above constraints, the Consultant believes that, in order to ensure feasible funding opportunities towards international financing institutions, the Project should be implemented through a staged approach.

The following phases would be suggested:

- Phase 2: carrying out of a long term action (2016-2025) focused on the realisation of a balanced wagon fleet (from the point of view of both fleet composition and age profile) and a modern and efficient maintenance organisation able to meet customer's expectations.

Phase 1 would consist in:

- refurbishing, through life-extension works, 228 wagons
- converting into covered and open wagons 452 wagons
- purchasing 346 new wagons
- rehabilitating existing maintenance facilities
- upgrading and specialising existing workshops, through:
 - supplying new spare parts
 - provision of modern equipment, suitable to perform operations of wagon life-extension, conversion and major overhaul.

The following investment costs have been estimated:

Table 48. - Phase 1 - investment cost estimate (USD at 2005 prices) Scenario A

	Foreign costs	Local costs	Total costs
Purchased of new wagons	24.250.027	0	24.250.027
Conversion of freight wagons	12.402.880	253.120	12.656.000
Refurbishment of freight wagons	4.679.892	95.508	4.775.400
Workshop rehabilitation	-	760.000	760.000
Purchase of workshop equipment	4.627.164	-	4.627.164
TOTAL	45.959.963	1.108.628	47.068.591

Phase 2 would provide the opportunity to review the demand for wagons against the projected traffic levels pertaining at that time. The Consultant has estimated it should consist in:

- refurbishing, through life-extension works, 336 wagons
- purchasing 853 new wagons

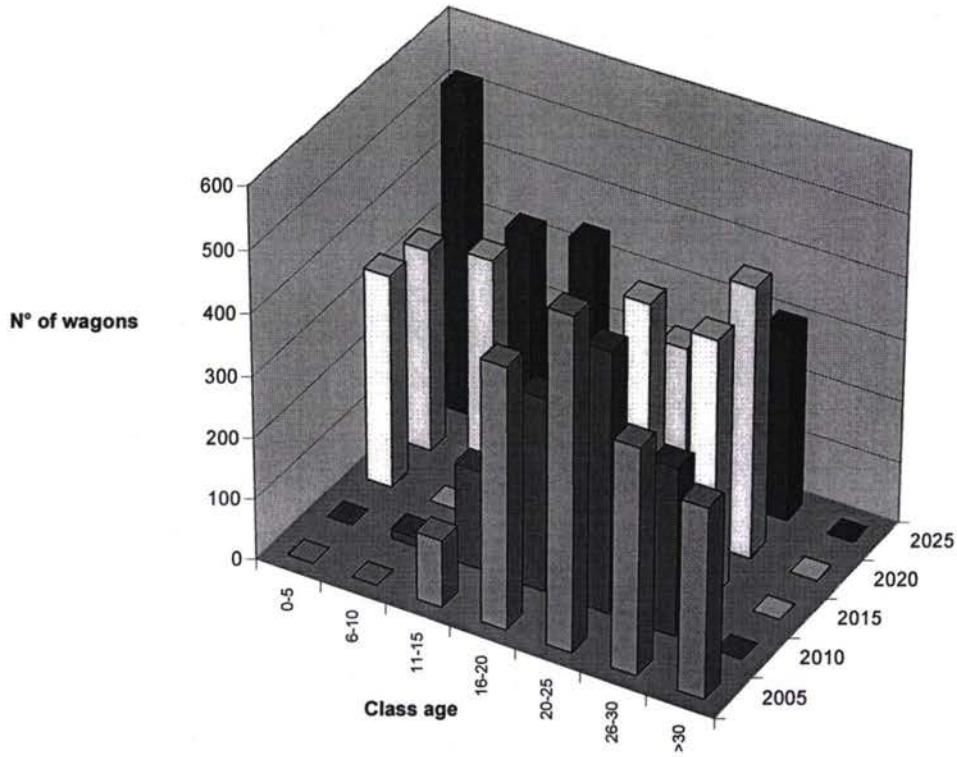
with a total cost of 113,8 million of US dollar.

Table 49. - Phase 2- investment cost estimate (USD at 2005 prices) Scenario A

	Foreign costs	Local costs	Total costs
Purchased of new wagons	59.693.235	-	59.693.235
Conversion of freight wagons	-	-	-
Refurbishment of freight wagons	6.910.764	141.036	7.051.800
Workshop rehabilitation	-	-	-
Purchase of workshop equipment	-	-	-
TOTAL	66.603.999	141.036	66.745.035

At the end of Phase 2 the age mix of the wagon fleet which should result is shown in figure 3.

Figure 3 – Scenario A – Wagon fleet age distribution



ANNEX 1

**Technical Specifications for
a project of technical assistance to the Tajik
Railways for the procurement of wagons**



A project implemented by Italferr S.p.A.

ANNEX 1

Technical Specifications for assistance to New Wagons Procurement Activities

1. Background and General aspects

The project aims at assisting TDZ in New Wagons Procurement Activities. The result of this activity shall consist in the individuation of the actions for the procurement of new wagons and equipment able to satisfy to the requirements of TDZ

For this purpose it is considered important to guarantee adequate technical support to TDZ wagon experts in the tasks of individuating and carrying out the activities necessary for the expected improvements.

2. Scope of the Work

2.1 General

The main goals of the activities for the procurement of new wagons and new equipment and components can be summarized as follows:

- to individuate updated technical specifications for the procurement of new wagons and relevant equipment such as to guarantee significant improvement in reliability and availability and reduction in maintenance costs, also taking into account the recommendations given by the consultant in the present document
- to select adequate suppliers able to satisfy these specifications
- to examine the technical aspects of the offers which will be presented in the tender stage.

To achieve such results, it is considered necessary that TDZ can rely on the support of a qualified international team in terms of technical assistance for the preparation of the relevant documents and performing a deep analysis of the international wagon suppliers market.

The whole project is based on the assumption that TDZ are adequately skilled with regard to the existing wagon fleet and its technical characteristics and performances, but they need some help for what concern the knowledge of the international freight wagons market and modern equipment and for the procurement of these stock.

2.2 Specific Activities

The main scope of work is the technical assistance for the procurement stages identification and the related tasks.

The role of the consultant shall start from the early stage of tender preparation and will include the following tasks:

- assistance to TDZ in the preparation of the tender documents

- assistance to TDZ in the identification of the tender process stages
- assistance to TDZ in the pre-qualification stage of the possible suppliers to be invited to the tender
- assistance to TDZ in the examination of the pre-qualification documents and references of the possible suppliers
- assistance to TDZ in the selection of the pre-qualified companies
- assistance to TDZ during the tender process
 - invitation to the international tender
 - definition of the tender assignment criteria
 - preparation of the technical and administrative documents
 - reception of the offers
 - examination of the offers
 - selection of the best offer
 - assignment of the contract
 - contract management

The analysis should be based on the examination of the scheduled maintenance cycles and of the most common failure modes and operational breakdown to wagon equipments.

Starting from this analysis a list of technical proposals for the replacement or performance improvement of components should be prepared, to be utilised for the procurement of new wagons.

This list should take into account some constraints such standardisation, interoperability and technical compatibility with existing equipment and wagons and maintenance facilities.

On the other hand it could be necessary to consider the possibility of the complete progressive replacement for the entire fleet of unreliable or maintenance high consuming items.

3. Logistics and Timing

3.1 Project Location

The project location will be in Tajikistan, mainly in Dushanbe, with some surveys to be carried out in the rest of the country for direct verification of wagon conditions and maintenance problems.

3.2 Project Duration

The total project duration is evaluated in 12 months mainly in connection with the development of the tender procedures.

4. Requirements

The project Team will be formed by at least two international key experts.

The percentage of time to be spent in Tajikistan by expatriated experts is around 75%.

The experts will work in close connection with TDZ technical engineers

4.1 Key Experts

The key experts will have qualified skills in freight rolling stock engineering and procurement.

The Team Leader is to be the rolling stock procurement key expert, with the following profile:

Education:

University education in mechanical engineering or equivalent

Experience and References:

At least 10 years experience in rolling stock procurement
Specific practical experience in freight wagon procurement

Field experience in TRACECA or PHARE countries

Knowledge of CIS countries rolling stock procurement market is desirable

Knowledge of Russian is also desirable

6 man-months should be allocated to the rolling stock procurement expert.

The profile for the rolling stock engineering key expert is the following:

Education:

University education in mechanical engineering or equivalent

Experience and References:

At least 10 years experience in rolling stock engineering
Specific practical experience in freight wagon design
Specific practical experience in freight wagon equipment

Field experience in TRACECA or PHARE countries

Knowledge of CIS countries rolling stock and technical specifications is desirable

Knowledge of Russian is also desirable

Allocation for the rolling stock engineering expert is 6 man-months

5. Reporting

Reports shall be prepared every three months during the development stages of the project tasks.

In these Reports all the main activities carried out during the period shall be summarized and the actions individuated shall be put into evidence.

Also the project organisation shall be described, especially in terms of the relation between the Team and TDZ experts.

At the completion of the project a final Report shall be prepared in which shall be presented the main actions defined for the improvement of wagon fleet reliability and availability and the main actions foreseen for wagon and wagon equipment procurement.

6. Criteria for the Selection of the Consultant

The main criteria for the selection of the consultant requested for the technical assistance should include:

- the evaluation of the company references in the field of wagon procurement at international level
- the evaluation of the CVs of the experts which the consultancy company will propose for the assistance team

For the selection of the consultant a formula could be proposed that takes into account, in a weighted proportion:

- total price
- man-months of on site assistance
- total of man-months of assistance
- company references
- experts CVs



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