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IMPROVING THE SUSTAINABILITY OF ROAD MANAGEMENT AND FINANCING IN AZERBAIJAN

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Abbreviations and Acronyms

AADT	Average Annual Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ADB	Asian Development Bank
ARS	AzerRoadService
BOT	Build-Operate-Transfer
BRMAC	Baku Road Maintenance and Advertisement Company
EBRD	European Bank for Reconstruction and Development
ECA	Europe and Central Asia
EU	European Union
FIDIC	International Federation of Consulting Engineers
FWD	Falling Weight Deflectometer
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GDP	Gross Domestic Product
GOA	Government of Azerbaijan
HDM-4	Highway Development and Management Model
IDA	International Development Agency
IFI	International Financial Institution
IT	Information Technology
JSC	Joint-Stock Company
KM	Kilometer
M Roads	Major Arterial roads
MoED	Ministry of Economic Development
MOT	Ministry of Transport
NCC	National Construction Council
NTCC	National Traffic Control Centre
OECD	Organization for Economic Co-operation and Development
O & M	Operations and Maintenance
PPP	Public Private Partnership
R Roads	Minor Arterial Roads
RAMS	Road Asset Management System
RMU	Road Maintenance Unit
RONET	Road Network Evaluation Tools Model
RTSD	Road Transport Services Department
SOFAZ	State Oil Fund
TRACECA	Transport Corridor Europe-Caucasus-Asia
UK	United Kingdom
VAT	Value Added Tax
Y Roads	Local roads

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Acknowledgments

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Executive Summary

A well-maintained road network that provides the level of service required by road-users is an important element of Azerbaijan's development strategy to accelerate economic growth and reduce poverty. As part of this strategy, the Government of Azerbaijan (Government) has undertaken major capital improvements on the major arterial road network. However, the secondary and local roads continue to be underfunded, and a large rehabilitation backlog has been accumulating in recent years. Deferred maintenance leads to a future burden of more expensive rehabilitation and road reconstruction: for every US$1 in deferred maintenance, there is an associated US$4 cost to road-users. To avoid such a scenario, the Government needs: (i) to devise an institutional and financing framework that provides adequate funding for maintenance and rehabilitation; and (ii) to finance capital improvements on key priority roads.

The objectives of this study (Study) are: (i) to identify the weaknesses and challenges confronting the sustainability of road maintenance and rehabilitation; (ii) to determine to what extent these factors are linked to particular institutional and financing arrangements; and (iii) to assess how these factors can be resolved. The Study makes a series of recommendations aimed at improving the management and financing of the road sector in Azerbaijan.

Key Issues

In the 1990s, the Azeri road sector had many shortcomings. These included: (i) a lack of specialized professionals, (ii) failure to execute maintenance and mayor works; and (ii) failure to utilize international standards. Since the establishment of the Ministry of Transport in 2003, Azerbaijan has been in the process of modernizing its road management practices. For example, Azerbaijan has developed a corporate plan, prepared road and land acquisition laws, and created a semi-autonomous joint-stock company—the AzerRoadService (ARS)—in 2007, to manage the road network. Since the establishment of the Ministry of Transport, civil works have been outsourced, International Federation of Consulting Engineers (FIDIC) contract types have been utilized, and loan agreements with IFIs have been concluded. The ARS has undertaken institutional strengthening activities—such as training and studies—in the areas of road maintenance, axle load control, road safety, project management and implementation. The company has taken steps that were needed for further strengthening the capacity, machinery and equipment pool of Maintenance Units. It is in process of preparing the legal and regulatory framework and operational procedures for toll roads, and developing new design and technical standards and studies on concessions. The ARS recognizes the importance of a functioning road asset management system (RAMS), and is in the process of preparing a road database and respective software and maps for subsequent development of a Road Master Plan—and evaluating how to strengthen the maintenance of local roads.

The implementation arrangements for road maintenance in Azerbaijan differ from a number of transition economies that are also undergoing modernization. In most transition economies, road agencies contract out road works, and in many cases are starting to implement performance-based contracts (PBCs). In contrast, all road maintenance works in Azerbaijan are done by force account. This means that the road agency carries out all aspects of road works "in house"—including directly supervising, managing, and controlling equipment and labor.[1] This is considered to be a more costly and less efficient method of carrying out road maintenance. The Study found that the condition of the majority of the road network remains poor, mainly due to the poor condition of local roads. Transport costs are high and connectivity to markets is poor, due to degraded rural infrastructure.[2] Over 60% of arterial roads are in good or fair condition, but only 29% of local roads. This reflects under-spending on local roads, because the Government has given higher priority to expenditures on arterial roads. The latter represent only 27% of the network, but carry 90% of the road traffic. The current asset value of the network is less than if the network had been maintained in good condition[3]. Given available data, the current value of the network is estimated to be US$7.0 billion. This is UD$1.3 billion less than the network would have been worth if it had been properly maintained—which translates into higher costs to road-users and to the economy.

In recent years, the Government's efforts have been focused mostly on new construction or road capacity improvements. The amount of funds directed at maintenance and rehabilitation has not been sufficient to eliminate the rehabilitation backlog—particularly for local roads. The Government's investment in new construction or capacity improvements of rural and urban road projects increased from US$13 million or 0.1% of GDP in 2005, to US$1.029 billion or 2.4% of GDP in 2009. During the same period, expenditures for road maintenance and rehabilitation remained at about 0.5% of GDP—and in 2010, the planned maintenance expenditures increased to 1.0% of GDP (US$515 million). A road fund was reinstated in 2007 to channel revenues for road maintenance. Currently, the latter does not receive any funds originating from fuel taxes.

The Government's objective is that the Major Arterial roads (M roads) will eventually attain international motorway standards for technical specifications, and operating and maintenance protocols—with a sustainable funding mechanism. The M roads total 1,900 km, of which 300 km have already been upgraded to four or more lanes. Over the next five years, the Government plans to upgrade an additional 700 km of M roads. It is one of the Government's development

[1] World Bank technical paper 409 "Commercial Management and Financing of Roads", by Ian Heggie and Piers Vickers recommends that a fairly efficient road agency should be able to manage a network with about five or less staff per 100 km. On networks with heavy traffic, the number may rise to 10 staff per 100 km. In Azerbaijan, the ratio is 54.6 staff per 100 km.

[2] Transport costs are road agency costs plus road-user costs that are a function of the road condition (Roughness). Road-user costs are typically around 90% of total transport costs.

[3] Current asset value computed accounting for the reduction of the network maximum asset value, which is the asset value considering all roads in good condition, function of the replacement value needed to bring fair and poor condition roads to good condition.

objectives to complete the north-south and the east-west road corridors by 2015. However, more effective maintenance practices will be needed for both the country's existing road network and the newly constructed motorway network in order for Azerbaijan to benefit fully from the anticipated economic returns.

The Government lacks a comprehensive system to track maintenance budget spending and outcomes, and it lacks a framework to monitor the performance of the road administration. There is limited information on: (i) the unit costs of road works; (ii) the amount of maintenance and rehabilitation road works executed annually; and (iii) the precise breakdown of expenditures by work activities. The ARS manages about 92% of the total 18,946 km road network in Azerbaijan. It has a total staff of 9,536, of which about 7,000 are assigned to 63 regional road maintenance units throughout the country. It has a labor force ratio of about 54.6 staff/100 km, which is high compared to more modern road agencies in transition economies. However, it should be taken into account that these other countries are contracting out maintenance works—and in Azerbaijan these works are performed by force account. Many European countries comparable to Azerbaijan in terms of road network size—such as Croatia and Latvia—have contracted out much of the routine maintenance work. With such a large labor force, most of the ARS maintenance budget is spent on salaries for staff in the maintenance department.

The Study estimated that the financing needed to bring the road network into a maintainable condition would be US$288 million per year for maintenance and rehabilitation works over a period of about five years. If used efficiently, this would minimize total transport costs, and thereby maximize the economic benefits to Azerbaijan. This amount is not substantially higher than the funds allocated to the ARS for maintenance and rehabilitation works: US$259 million in 2008, US$243 million in 2009, and U$515 million in 2010. Thus, the amount of funding for maintenance and rehabilitation works could be sufficient. However, the major issue appears to be whether these resources are being used efficiently.

Currently, there is no inventory of road assets, no recent condition surveys, and no systematic traffic counting in Azerbaijan. However, the ARS recently hired a consultant firm to collect data for a roads and bridges inventory, to monitor road conditions and traffic for two years, and to establish a RAMS—all of which is essential for the proper monitoring and planning of road works.

The ARS has a website to collect users' feedback, but it does not have a well-established system to inform citizens about road and traffic conditions, and its website does not include updated information. Neither the ARS nor the Ministry of Transport (MOT) undertake systematic surveys to assess road-users' satisfaction with the services provided—although the ARS does have a telephone number and website where users can express their opinions and complaints.

Institutional Issues

- *Strengthen the Planning Unit within the ARS.* The ARS should support the Planning Unit and use road condition surveys to plan maintenance and improvement works. The Planning Unit should house the Road Data Management Unit (RDMU), for managing the RAMS;

- *Create a Motorway Unit within the ARS or a separate Motorway Agency.* The motorway management is deficient—it could be strengthened either by the establishment of a Motorway Unit within the ARS or through a separate Motorway Agency. The Motorway Operation and Maintenance Component of the World Bank-financed Third Highway Project will enable the ARS to consider different management options for motorways, and implement the most appropriate one for Azerbaijan;

- *Move towards road maintenance contracting.* The Government should gradually start using the private sector for road maintenance activities. It should transform the in-house labor for road maintenance into road maintenance enterprises—under a well-structured plan that might entail the restructuring of the regional road maintenance units. The ARS could set up regional maintenance management ('client') divisions to be functionally separate from the existing maintenance works units ('suppliers');

- *Identify a core network of local roads.* The ARS should use the road network condition survey to identify a core network of local roads. On local roads, daily traffic is a less important factor than the roads' social functions. Therefore, the criteria used to identify core roads should include access to social services and economic centers, in order to better focus the investments in rehabilitation and maintenance. Once the core network has been defined, the ARS should focus on maintaining the quality of the core road network at an appropriate level, instead of the current practice of rehabilitating a few sections of local roads;

- *Develop a motorway corridor management approach.* The ARS should adopt a policy of managing the main transport corridors—starting with the motorways—to ensure that the same level of service is maintained throughout an entire corridor. The Government is particularly concerned with preserving the substantial investments made in motorways, and ensuring that they are operated and maintained according to international standards;

- *Establish a dedicated Road Data Management Unit (RDMU) within the ARS to manage and evaluate the road network data.* The RDMU should have permanent staff, a secured budget, and clear terms of reference. The unit can initially be located within the Investment Division, where there is current expertise on road network data management and evaluation. Eventually, it can be relocated to the Maintenance Division or a newly created Planning Unit;

- *Establish a comprehensive road network database*. Ensure that a road network database and a RAMS are fully operational and able to manage all of the road network data to be collected in the future. The RAMS should have an efficient interface to the Highway Development and Management Model (HDM-4)[4] and to a mapping interface; and it should be able to produce management reports to support the decision-making process. In order to avoid problems faced with previous attempts to implement a RAMS, strong counterpart staff is needed to work with the consultants who will implement the new RAMS;

- *Improve coordination between the different Governmental organizations involved in the road sector*. The execution of road works requires the involvement of other Governmental organizations alongside the ARS. Thus, there is a need to simplify the road administration relations with other Governmental organizations and the procedures regulating these relations; and

- The ARS should demonstrate accountability to the public, including periodically carrying out road-user satisfaction surveys.

Financing Maintenance and Rehabilitation Expenditures

- *Enhance capacity to commission and review feasibility studies*. The ARS will need to strengthen its capacity to comply with the requirements of the Presidential Decree No. 239 on the preparation, implementation and monitoring of public investment projects. Preferably this responsibility should fall within the remit of the Planning Unit under the ARS.

- *Consider the option of increasing fuel levies and including these additional revenues within the Road Fund, because they relate to road usage, are easily recognizable, and are simple to administer.* This recommendation reflects the view that: (i) the Road Fund should collect all funds needed for routine and periodic maintenance for all inter-urban roads and part of the urban road network; and (ii) the overall Road-user charges should cover operation, maintenance and depreciation of the roads, as well as environmental and other social costs.

[4] HDM-4 is a tool developed by the international roads community for the economic evaluation of road projects. It: (i) assesses the current network condition and traffic; (ii) determines maintenance and rehabilitation road works that minimize total transport costs or the costs of sustaining the network in its current condition; (iii) estimates the savings or the costs to the economy to be obtained from maintaining the network at different levels of road condition; (iv) determines the proper allocation of expenditures between recurrent maintenance, periodic maintenance, and rehabilitation road works; and (v) determines the "funding gap", which is defined as the difference between current maintenance spending and required maintenance spending, and the effect of under-spending on increased transport costs.

- *Introduce an Operation and Maintenance (O&M) concession on a pilot basis along specific road corridors.* O&M concessions are similar to performance-based maintenance contracts, but they have longer terms—generally between 15 and 25 years. Therefore, they may include more important rehabilitation and/or upgrading works—consistent with the expected traffic growth over the longer period of the contract. They may also include broader obligations with respect to operations, including emergency, mechanical and traffic information services to road-users.

- *Prepare future financing plans for the maintenance and rehabilitation of the road network.* Future financing plans for the road sector should take into account four main objectives:

    (a) Maintain for the upcoming five years a level of maintenance and rehabilitation expenditures of around US$288 million per year—which is the option that minimizes total transport costs;

    (b) Improve the cost effectiveness of maintenance and rehabilitation expenditures by contracting out maintenance and rehabilitation works;

    (c) Plan the size of the road network to be consistent with long-term macroeconomic forecasts. This would require strengthening the Road Fund to secure funding for maintenance and rehabilitation works, and performing the economic evaluation of development works based on realistic traffic projections; and

    (d) Implement more cost-effective contracting practices aimed at protecting current assets and the substantial investments made in motorways—and achieve better efficiency on maintenance and rehabilitation works expenditures.

Maintenance and Rehabilitation Standards

- *Review Road pavement design standards.* Many roads in Azerbaijan carry much heavier traffic than they were designed for, which results in significant damage. Pavement standards in Azerbaijan are not based on the equivalent standard axle (ESA), which requires factoring in forecast traffic demand over the design life to determine pavement strength.[5] There is a study being undertaken to review and revise the geometric and structural standards that is expected to be completed by the end of 2011. The ARS should consider implementing the recommendations of that study;

[5] The crucial factor in the design of a pavement in the EU and the US is the Equivalent Standard Axle (ESA), which involves converting the traffic demand forecast into an estimate of ESAs over the design life to determine pavement strength.

- *Review design standards for local roads*. The design standards used to rehabilitate local roads are often higher than justified by the level of traffic. Therefore, the limited financial resources are allocated to the rehabilitation of a few segments of roads without improving the overall quality of the network—this winds up increasing total transport costs. In the long-run, over-designed standards penalize road-users;

- *Increase capacity of selected roads.* The capacity of selected roads can be increased by widening them to four lanes if justified by traffic demand. There will be a growing need in Azerbaijan to increase road capacity, because vehicle ownership is expected to continue growing fast;

- *Define road maintenance standards and performance indicators*. Currently there are no codified maintenance standards that are used for assessing road performance. Consequently, there are no specific performance targets for road maintenance. These indicators could be valuable for devising PBCs. The selection and definition of indicators should be based on: (i) road-user needs; (ii) the expectation of the client to have assets back on contract completion at a condition defined in the contract; and (iii) affordability—or the level of funding available. The definition of performance indicators should be simple, clear, and easy for the contractor to understand and assess.

Summary

Table 1 presents key priority recommendations for each road class that would make a high short-term impact on the sustainability of road management in Azerbaijan.

Table 1. High Priority Recommendations

Road Class	Main Focus	Key Recommendations
Main Road Corridors	Ensure that an entire corridor has the same level of service	a) Establish a corridor management scheme
M and R Roads	Maintain the existing road assets by the proper monitoring, planning and programming of maintenance works	a) Establish a road asset management system to track maintenance budget spending and outcomes b) Move towards road maintenance contracting to the private sector
Y Roads	Promote reliable and cost-effective access to as much rural population as possible, rather than high standards for a few	a) Define a core local road network

A. Introduction

1. A well-maintained road network that provides the level of service required by road-users is an important element of Azerbaijan's development strategy to accelerate economic growth and reduce poverty. As part of this strategy, the Government of Azerbaijan (Government) has undertaken major capital improvements on the major arterial road network. However, the secondary and local roads—which are important for access of the rural population to markets and social services—continue to be underfunded, and a large rehabilitation backlog has been accumulating in recent years. Deferred maintenance leads to a future burden of more expensive rehabilitation and road reconstruction: for every US$1 in deferred maintenance, there is an associated US$4 cost to road-users.[6] To avoid such a scenario, the Government needs: (i) to devise an institutional and financing framework that provides adequate funding for maintenance and rehabilitation; and (ii) to finance capital improvements on key priority roads.

2. The implementation arrangements for road maintenance in Azerbaijan differ from a number of transition economies that have undergone modernization. In most transition economies, road agencies contract out road works—and they are, in many cases, starting to implement performance-based contracts (PBCs). In contrast, in Azerbaijan all road maintenance works are done by force account. This means that the road agency carries out all aspects of road works "in house"—supervising, managing, and controlling equipment and labor directly. The force account approach is considered to be a more costly and a less efficient method of carrying out road maintenance—therefore, the Study focuses in detail on the options for reforming road maintenance practices.

3. The objectives of this study are: (i) to identify the weaknesses and challenges confronting the sustainability of road maintenance and rehabilitation; (ii) to determine to what extent these factors are linked to particular institutional and financing arrangements; and (iii) to assess how these factors can be resolved. The Study makes a series of recommendations aimed at improving the management and financing of the road sector in Azerbaijan.

a) First, the Study provides an overview of the road sector and the condition of the road network. Then it turns to a review of road management and financing in Azerbaijan. The Study reviews the current institutional and technical arrangements, with regard to the ability to effectively plan, design, construct, and maintain the road network. It gives particular emphasis to the implementation arrangements for the road sector, including: (i) budgeting; (ii) management and resources; (iii) technical standards in use; (iv) quality assurance and education/training; and (v) provision of maintenance for different road

[6] Road-user costs refer to fuel, lubricants, tire, crew, maintenance parts and labor, depreciation, interest, overheads, and passenger and cargo time costs. This scenario can be found in the World Bank Policy Paper "Road Deterioration in Developing Countries – Causes and Remedies" published in 1988. According to the paper, road conditions in 85 developing countries have a maintenance backlog of an estimated US$40-45 billion that could have been avoided had timely maintenance costing less than US$12 billion been carried out.

classes. It then assesses actual expenditures for the maintenance and rehabilitation of different road categories using the Highway Development and Management Model (HDM-4)[7], before exploring different options for financing road maintenance in a sustainable manner. It concludes with a series of recommendations. Key principles underlying the review are the following:

b) **Sustainable road maintenance financing**, to ensure that road maintenance and rehabilitation funds are sufficient to keep the network operating at an acceptable level of service;
c) **Efficient allocation of resources**, to ensure that resources are distributed among different uses so as to maximize their contribution to the objectives of the road sector; and
d) **Value-for-money**, to ensure that the results are achieved at the least possible resource cost.

4. The Study was informed: (i) by data collected in Azerbaijan; (ii) by a review of the existing work in the sector—particularly the various technical assistance activities undertaken by different International Financial Institution (IFI) financed projects; and (iii) by interviews with Government officials and other stakeholders in Azerbaijan. The findings of the Study are timely. It is hoped that they will inform a policy discussion on the need to raise expenditures on maintenance of the road network, and provide a roadmap for financing these needs in an efficiency, cost-effective manner.

B. Overview of the Azeri Road Sector

5. **Azerbaijan is a strategically important country, as a key link geographically in the East-West and North-South corridor, and as a key source of oil and gas resources.** Azerbaijan shares a border with five other countries: the Russia Federation, Georgia, Armenia, Turkey and Iran. It is the largest and most populous country in the South Caucasus—with a population of about 8.7 million inhabitants, 54% of whom live in urban areas. The country has experienced impressive real GDP growth in recent years coupled with significant poverty reduction—driven largely by oil and gas production.

[7] HDM-4 is a tool developed by the international roads community for the economic evaluation of road projects. It: (i) assesses the current network condition and traffic; (ii) determines maintenance and rehabilitation road works that minimize total transport costs or the costs of sustaining the network in its current condition; (iii) estimates the savings or the costs to the economy to be obtained from maintaining the network at different levels of road condition; (iv) determines the proper allocation of expenditures between recurrent maintenance, periodic maintenance, and rehabilitation road works; and (v) determines the "funding gap", which is defined as the difference between current maintenance spending and required maintenance spending, and the effect of under-spending on increased transport costs.

6. **In recent years, the Government has used oil-related revenue to fund an ambitious public investment program.** Azerbaijan inherited an adequate infrastructure network after independence, but the poor state of the economy during the 1990s and low availability of funding before the oil boom led to its significant degradation. Prior to the country's oil boom, infrastructure investment rates in Azerbaijan were low and the country was facing an investment deficit. As a result, by 2005, most infrastructures had outlived their useful lifespan of 25-30 years, and overall infrastructure quality and reliability was poor. From 2005-2009, the Government invested about US$9 billion in infrastructure; about half was allocated to the road sector, which represents a significant commitment to infrastructure development. Azerbaijan has weathered the global economic crisis relatively well. Nevertheless, the crisis has underlined the need for a diversified non-oil economy, market-based policies, and strengthened social services and support—particularly because the country may experience a severe fiscal adjustment at the end of its oil and gas boom.[8]

7. **Expenditures need to be assessed in terms of sustainability over the medium- to long-term with regard to the non-oil economy**. First, it is important that road maintenance receives its fair share in any investment plan. Second, priority should be given to road sector investments that will contribute quickly and directly to supporting economic growth by: (i) strengthening inter-country linkages; (ii) providing greater export market access to local producers; and (iii) increasing Azerbaijan's role in the East-West and North-South transit corridors. Third, the objective of diversifying the Azeri economy, coupled with the fact that about 38% of employment is in the agricultural sector, highlights the potential of rural areas as a priority for unleashing productivity gains and reducing poverty. Therefore, particular importance should be given to local roads to ensure that rural populations have basic all-weather access. Fourth, the focus on sustainability in a post-oil boom era means that special attention should be paid to mechanisms that will ensure increased efficiency of all road expenditures.

8. **Transport in Azerbaijan is dominated by the road sector**. Since 1990, over 98% of passenger travel has been by roads. The modal shift is less dramatic but also noticeable in the case of freight. From 2005 to 2009: road passenger and road freight volumes increased more than ten-fold; meanwhile, railways' freight market share dropped from 27% to 22%. Railways are key in oil-dominated transit, but road infrastructure and road transport services dominate in daily living and economic development.

[8] At present, Azerbaijan's overall macroeconomic situation is stable—with high growth rates, and an accumulating oil fund that should reach over US$20 billion by the end of 2010. However, oil revenues are likely to plateau over the coming decade, and decline thereafter. Although the adjustment could be mitigated with resources saved in the Oil Fund during boom times, this will need to be accomplished in the context of a careful domestic demand investment review and prioritization, so as not to exceed a prudent overall spending limit. Sustainability requires Azerbaijan to moderate its fiscal expenditures in the short- and medium–term, because fiscal revenues from oil and gas are expected to decline significantly in the medium-term in both nominal terms and as a percentage of non-oil GDP. Azerbaijan will have to increasingly rely on the private sector and non-oil exports to generate growth.

Road Network

9. **The total length of the Azeri road network is 18,946 km**. The AzerRoadService (ARS) manages 17,473 km of the network, and the Nakhavtoyol road agency manages the other 1,473 km.[9] The network is sub-divided by functional classification into three classes: (i) major arterial roads (M roads); (ii) minor arterial roads (R roads); and (iii) local roads (Y roads). The major transportation and transit corridors are the North-South corridor (M1 and M3) and the East-West corridor (M2 and M4). The M1 links Baku to the Russian border, and the M3 links Baku to Iran. The M2 is a part of the Great Silk Road. The M2 is the main route between Baku and Tbilisi; and it is a part of the Transport Corridor Europe-Caucasus-Asia (TRACECA)[10] route E-60, which is a main corridor between Western Europe and China[11]. The M4 runs from Baku to Shamakhi; it merges at Yevlakh into the M2. The World Bank, through three highway projects, has been supporting the Government in upgrading this ARS network.

10. **The M and R roads represent only 27% of the ARS road network, but carry over 90% of the traffic.** The average daily traffic is 5,100 vehicles per day on the M roads and 2,200 vehicles per day on the R roads. Only 54% of the total ARS network—all M and R roads, but only 37% of Y roads—is paved, which is low compared to most Western European countries. Table 2 presents the network length by network type and number of lanes—with the exception of M roads all roads have only two lanes. The road density—at 223 km per 1,000 square kilometers (sq. km)—is lower than a number of EU-15 countries and other neighboring countries. The road network density of Azerbaijan is about 2.2 km per thousand persons, which is significantly below the levels in a number of European countries.[12]

Table 2. The ARS Road Network (km)

	2 Lane	4 Lane	6 Lane	Total	2L Equivalent[13]
M Roads	1,353	254	77	1,684	2,092
R Roads	2,673	0	0	2,673	2,673
Y Roads	13,116	0	0	13,116	13,116
Total	17,142	254	77	17,473	17,881

Source: ARS.

[9] There are also other municipal and private roads. Road network data for the roads managed by the Nakhavtoyol road agency is unavailable—therefore, only roads managed by the ARS are discussed in this report.

[10] TRACECA is an international transport program involving the EU and 14 member States of the Eastern European, Caucasian and Central Asian region. Since 2009, the organization has been financed by member countries.

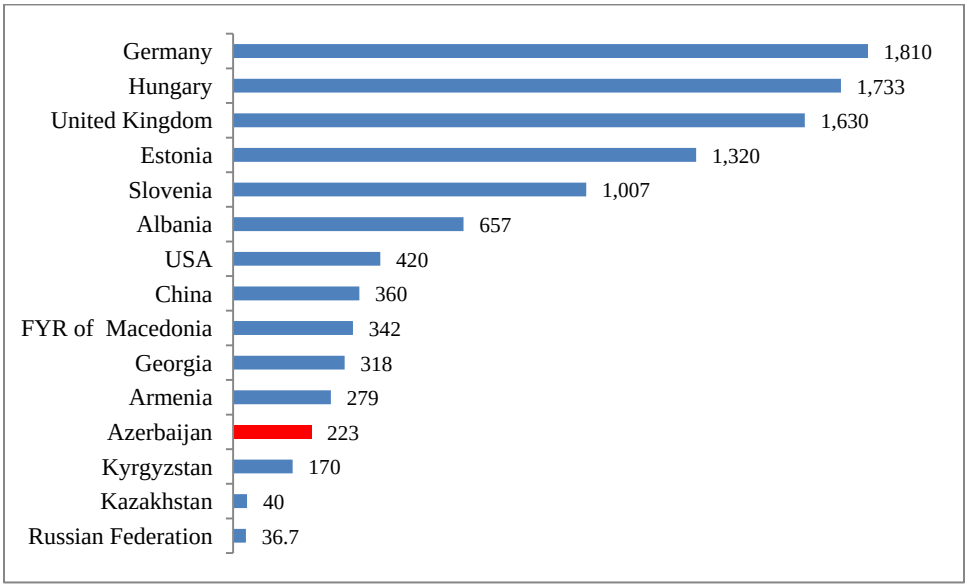
[11] The Bank is supporting the upgrading of the Georgian section of the E-60 from two lanes to four lanes through sequential projects: the First, Second, and Third East-West Highway Improvement Projects.

[12] The road density per 1,000 people is 3.5 in Albania, 2.6 in Armenia, 41.2 in Estonia, 4.3 in FYR Macedonia, 15.1 in Georgia, 5.7 in Hungary, 7.1 in Kazakhstan. 6.3 in Kyrgyzstan, and 10.2 in Slovenia.

[13] The two-lane equivalent network length is calculated using the HDM-4, and used to assess the maintenance and rehabilitation needs of the network.

11. **The majority of the road network remains in poor condition.** The operating costs to road-users are generally high. Some local roads are impassable during winter, which means that rural communities lack access to services for several months of the year. The road condition is poor due to the inferior quality of construction and materials used, and the lack of regular preventive maintenance after road construction and rehabilitation. A 2006 study identified Azerbaijan as one of the countries with the poorest road infrastructure in the ECA region.[14] As shown in Table 3 below, only 38% of the total ARS network—74% of M roads, 56% of R roads and 29% of Y roads—are in good or fair condition. In other words, 62% of the total roads require expensive rehabilitation works. Regarding the M and R roads, 65% are in good or fair condition. This is in line with an international benchmark—usually about 70% of main roads are in good or fair condition in developing countries.

Figure 1. Road Density (km per sq. km of land area)



Source: World Bank.

12. **The current asset value of the ARS road network is estimated to be US$ 1.3 billion less than what it could have been if the entire network had been kept in good condition.** This represents 36% of non-oil GDP and 84% of the maximum possible asset value (US$ 8,331 million), as computed assuming that all roads were in good condition (Table 4 and Figure 2).[15] The poor quality of roads represents a risk to Azerbaijan's expansion as a transit country. Furthermore, poor road conditions increase accidents, vehicle damage, and CO2 emissions. Figure 3 presents the main characteristics of the M and R roads; it shows that the M roads carry most of the traffic and are in better condition (Figure 3).

[14] Shepherd, Ben and John S. Wilson, *Road Infrastructure in ECA: Does Network Quality Affect Trade?* 2006.

[15] Current asset value computed with the HDM-4 accounting for the reduction of the network maximum asset value, which is the asset value considering all roads in good condition, function of the replacement value needed to bring fair and poor condition roads to good condition.

Table 3. Length and Condition of the ARS Road Network

Network	Good	Fair	Poor	Very Poor	Total	Percent	Good or Fair
M Roads	975	563	519	36	2,092	12%	74%
R Roads	398	1,107	1,005	163	2,673	20%	56%
Y Roads	131	3,607	6,243	3,135	13,116	73%	29%
Total	1,504	5,276	7,767	3,333	17,881	100%	38%
Percent	8%	30%	43%	19%	100%		
Network	Good	Fair	Poor	Very Poor	Total	Percent	Good or Fair
M and R Roads	1,373	1,669	1,524	199	4,765	36%	64%
Y Roads	131	3,607	6,243	3,135	13,116	73%	29%
Total	1,504	5,276	7,767	3,333	17,881	100%	38%
Percent	8%	30%	43%	19%	100%		
Network	Good	Fair	Poor	Very Poor	Total		
M and R Roads	29%	35%	32%	4%	100%		
Y Roads	1%	28%	48%	24%	100%		
Total	8%	30%	43%	19%	100%		

Note; Based on a sample roughness measurements taken in 2010 and assumes two-lane length equivalent length.
Source: World Bank.

Table 4. ARS Roads Current Condition and Asset Value

Network	Length (km)	Utilization (M veh-km/yr)	Paved Roads (%)	Good/Fair Roads (%)	Max. Asset Value (US$ Mil)	Current Asset Value (US$ Mil)	Current Asset Value per GDP (%)	Avg Traffic (AADT)
M Roads	2,092	3,935	100%	74%	4,184	3,919	20.1%	5,154
R Roads	2,673	2,146	100%	56%	2,673	2,242	11.5%	2,200
Y Roads	13,116	531	37%	29%	1,474	876	4.5%	111
Total	17,881	6,613	54%	38%	8,331	7,037	36.0%	1,013

Source: HDM-4 Evaluation

Figure 2. ARS Roads Asset Value

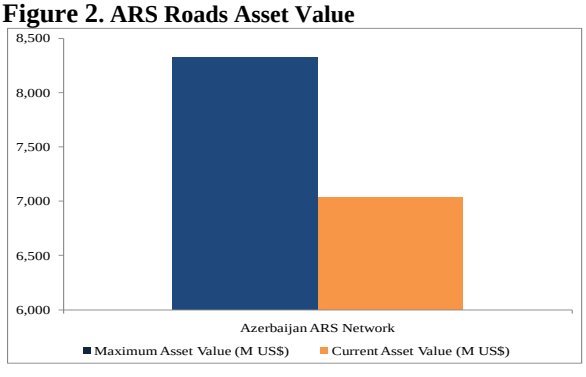
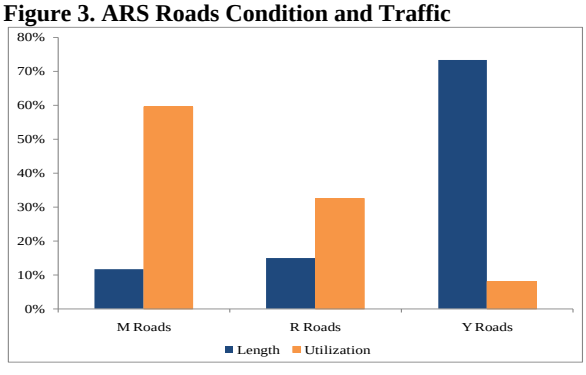


Figure 3. ARS Roads Condition and Traffic



Sources: World Bank; ARS.

13. **There is a need to increase the capacity of some roads by widening them to four lanes.** From 2004-2010, vehicle ownership increased rapidly due to economic growth. In 2009, the total Azerbaijan vehicle fleet was about 926,000, or 105 vehicles per 1,000 inhabitants—about 22% of the average car ownership in EU-15 countries. Vehicle ownership in Azerbaijan is expected to continue growing. Therefore, there is a need to increase the capacity of some roads by widening them to four lanes; this is further justified by the high accident rates of two-lane roads in Azerbaijan. In 2009, there were about 10 fatalities per 10,000 vehicles in Azerbaijan—more than five times the rate of best practice countries.

14. **Road design standards.** Many of these roads now carry traffic comprised of a high number of heavy trucks with European dimensions. When the EU new member states accepted increases in vehicle axle loads and maximum vehicle weights as part of the *acqui communautaire*, they were forced to invest heavily in upgrading their road networks to new design standards in order to avoid the heavy damage to roads and bridges that would have otherwise resulted. The inappropriateness of the Azeri road designs for the new demands being made on the road structures is restraining economic and social growth. In addition, Azeri pavement standards are not based on equivalent standard axle (ESA), which requires factoring in forecast traffic demand over the design life to determine pavement strength.[16] Various international (e.g., Russian, US, British, German) technical standards, specifications and guidelines are followed in design and construction/rehabilitation of road projects that have international financing. The ARS expects that a consultancy assignment, under World Bank financing, will review current standards—for geometric and structural design, and road maintenance—and recommend, by the end of 2011, the adoption of more modern standards in line with international best practice, for example, from the EU or the American Association of State Highway and Transportation Officials (AASHTO). The large number of overloaded trucks traveling the network is a serious concern that results in early deterioration of road investment. The ARS contracted Finnroad under the ADB project to study the overloaded trucks problem (Axle Load Survey, 2009). The findings were that a significant number of trucks traveling the network were overloaded (sometimes up to 17 tons). The problem is with enforcement of axle loads: therefore, there is a need to design a strategy to operate vehicle weighing stations and to enforce the existing regulation.

15. **Conversely, the design standards used to rehabilitate local roads are often higher than justified by the level of traffic.** Therefore, the limited financial resources are allocated to the rehabilitation of a few segments of roads without improving the overall quality of the network—and this winds up increasing total transport costs. For example, rehabilitating a low-volume road with an overlay of 80mm instead of 50mm, will not only increase the rehabilitation costs by around 40%, but will also increase the present value of total transport costs (road agency

[16] In the EU and the US, the crucial factor in the design of a pavement is the Equivalent Standard Axle (ESA), which involves converting the traffic demand forecast into an estimate of ESAs over the design life to determine pavement strength.

plus road-user costs) over a 20-year evaluation period by 2%; thus over-design standards penalize road-users in the long-run. In addition, funding of routine and periodic maintenance in Azerbaijan is very limited, which results in faster than anticipated deterioration of road assets. This approach ends up being very expensive and unsustainable, because the improved sections will deteriorate before the rest of the network is improved.

Institutional Setup

16. **In 2003, the Road Transport Services Department (RTSD) was established—under the Ministry of Transport (MOT)—to assume overall responsibility for policy, regulation and administration of the transport sector**.[17] In 2007, the RTSD was transformed into a semi-autonomous joint-stock company, the AzerRoadService (ARS), which reports to the MOT. The objective of this institutional and organizational change was to improve road sector management and enhance efficiency by increasing the road agency's authority, autonomy and flexibility of operations.There **are a number of issues that need to be addressed with regard to the existing organizational structure of ARS—particularly with regard to road maintenance**. The Maintenance Department at the ARS headquarters does not use road condition surveys to monitor the network and plan maintenance. Instead, maintenance is managed by regional maintenance units. The maintenance budget is allocated among 63 regional maintenance units throughout the country, each one responsible for road maintenance of main (M and R) and local (Y) roads in their respective region. Funds are allocated according to the "needs-based" approach, and have no direct link to the rehabilitation backlog or a detailed economic analysis of priorities—because no overall plan exists for routine repairs or periodic maintenance. Planning of improvement works is also not done in a comprehensive manner. Thus, there is a need for strengthening the planning functions within the ARS in order to evaluate the preservation and development needs of the road network. The Study also found that motorway management is deficient, and could be strengthened either by the establishment of a Motorway Unit within the ARS or through a separate Motorway Agency. In addition, the study recommends that a Road Data Management Unit be established—under the proposed Planning Unit—for managing the road asset management system (RAMS). All of these recommendations require changes in the organizational structure of ARS.

17.

18. Figure 4 presents the organizational structure of the ARS. The mission of the ARS—although such a mission statement is not formally published or disseminated—is to ensure uninterrupted and safe use of main and local roads in Azerbaijan, and to ensure that those roads

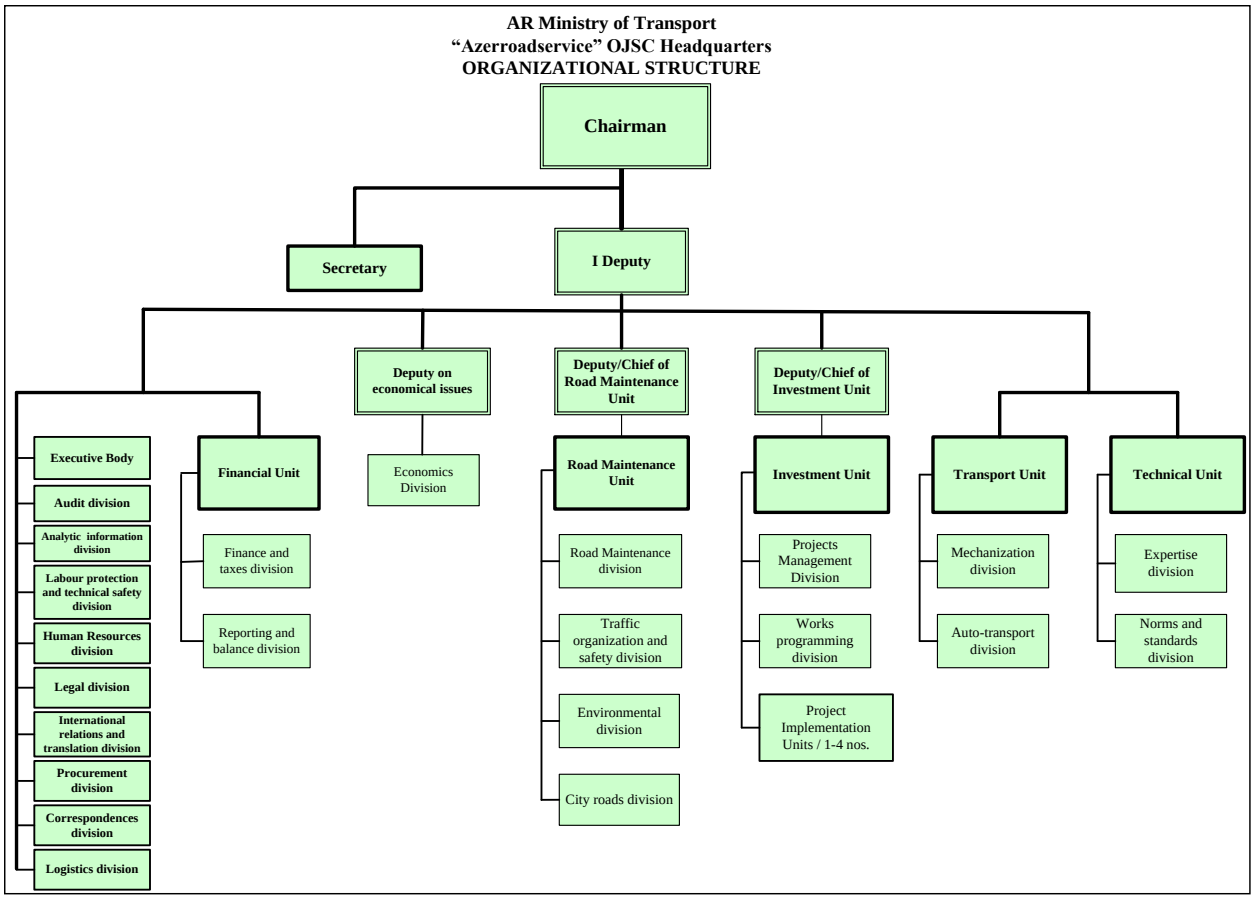
[17] Azerbaijan Law on Automobile Roads (2003). The Law on Automobile Roads (2003) requires some amendments that were prepared and presented to the Government, but approval is pending. Prior to this, from 1993-2003, the road sector was managed by Azeravtoyol, a state concern that was modeled on the centralized decision-making system. The Government dissolved it, because it continued to perform poorly and was under civil service salary scale.

approach EU standards of serviceability. The ARS is regularly audited by the Chamber of Accounting and Chamber of Auditors—and its performance is monitored by MOT. The execution of road works requires the involvement of other Governmental organizations alongside the ARS. Thus, there is a need to simplify road administration relations with other Governmental organizations and the procedures regulating those relations.

19. **There are a number of issues that need to be addressed with regard to the existing organizational structure of ARS—particularly with regard to road maintenance**.[18] The Maintenance Department at the ARS headquarters does not use road condition surveys to monitor the network and plan maintenance. Instead, maintenance is managed by regional maintenance units. The maintenance budget is allocated among 63 regional maintenance units throughout the country, each one responsible for road maintenance of main (M and R) and local (Y) roads in their respective region. Funds are allocated according to the "needs-based" approach, and have no direct link to the rehabilitation backlog or a detailed economic analysis of priorities—because no overall plan exists for routine repairs or periodic maintenance. Planning of improvement works is also not done in a comprehensive manner. Thus, there is a need for strengthening the planning functions within the ARS in order to evaluate the preservation and development needs of the road network. The Study also found that motorway management is deficient, and could be strengthened either by the establishment of a Motorway Unit within the ARS or through a separate Motorway Agency. In addition, the study recommends that a Road Data Management Unit be established—under the proposed Planning Unit—for managing the road asset management system (RAMS). All of these recommendations require changes in the organizational structure of ARS.

[18] The most critical issues facing the ARS were identified during interviews with management and staff during a Bank mission in autumn 2010. They include: (i) shortage of financial resources (particularly for road maintenance); (ii) need to enhance staff capacity; (iii) poor condition of local roads (which have been neglected because most budget allocations go to arterial roads); and (iv) insufficient involvement of the private sector. Regarding the latter, the ARS recognizes that, when transferring some services to the private sector, it will be critical to review and adopt the most appropriate forms of contract. Less staff—but better paid staff and modernized human resources practices—are needed to better manage the network.

Figure 4. ARS Organizational Structure



Source: ARS.

20. **There appear to be no legal constraints to contracting out road maintenance in Azerbaijan**. In fact, the Baku Road Maintenance and Advertisement Company (BRMAC, a LLC company), which was established in 2004 under the ARS, has been contracting out with private companies—both local and foreign, including a Turkish contractor. However, most road maintenance carried out by the BRMAC is done by its own staff, equipment and plants. The BRMAC was created by the ARS to maintain the strategic roads system in Baku city, such as the roads linking Baku to the international airport. The company's salaries are higher than those of the ARS. It receives monthly budget allocations from the ARS as proposed by the company and agreed upon with the ARS. A detailed review of BRMAC has not been conducted, but overall, it seems to operate satisfactorily. It is expected that similar road maintenance organizations will be established in future, including ones to maintain the country's motorways. Options to improve road maintenance and management in Azerbaijan include:

a) Developing a corridor management scheme for the main transport corridors—starting with the motorways—that will ensure that the same level of service and a sustainable funding mechanism will be provided throughout an entire corridor;
b) Identifying of a core local road network, to prioritize expenditures on main local roads from a social and economic perspective;
c) Replacing the force account approach with traditional method-based contracts for maintenance works;
d) Using PBCs for maintenance and rehabilitation works (see Annex 2);[19]
e) Using road maintenance and operation concessions—and possibly charging tolls on roads with relatively high traffic volumes;
f) Using Build-Operate-Transfer contracts (BOTs) to construct new roads or upgrade existing roads, charge tolls, and carry out long-term maintenance and rehabilitation.[20]

21. **The options above would be facilitated by creating a Planning Unit within the ARS.** The road and bridge database—which is currently being developed—should be housed under this new department. The experience gained with the BRMAC in contracting out road maintenance could be extended to the regions—for example, by restructuring or transforming some pilot RMUs into limited-liability companies, which could contract out maintenance works in their respective regions. The responsibilities of the Planning Unit might include: (i) monitoring the network and road works activities; (ii) evaluating alternative policy options; (iii) proposing the allocation of resources for the road sector; (iv) preparing network preservation and development plans; and (v) assessing feasibility studies and cost benefit evaluations.

22. **The Study recommends that the Government should start to gradually get the private sector involved in road maintenance activities by transforming force account road maintenance to contracting under a well-structured plan that could entail the restructuring of the regional road maintenance units.** It is essential for Azerbaijan to have a modernized maintenance department with an accounting information system that can monitor performance and with right-sized workforce—particularly, in order to improve the cost-effectiveness of maintenance. For example, the ARS could implement more cost-effective contracting practices, such as traditional method-based contracts and multi-year road maintenance and rehabilitation PBCs, on a pilot basis.

23. **During a transition period, the aim would be to separate client and supplier functions for maintenance to improve efficiency.** The ARS could set up regional maintenance management (‘client’) divisions within the Maintenance Directorate of the ARS to be functionally separate from the existing maintenance works units (‘suppliers’). This has been

[19] Guidance and examples of PBC implementation are available, for example, in the World Bank PBC Resource Guide: http://www-esd.worldbank.org/pbc_resource_guide/index.html
[20] Guidance and examples of PPP implementation in roads are available, for example, in the World Bank Toolkit for PPP in Roads and Highways:
http://www.ppiaf.org/ppiaf/sites/ppiaf.org/files/documents/toolkits/highwaystoolkit/index.html

proposed in the ARS's Corporate Plan, which aims to develop a new model of road maintenance practices. The aim of maintenance management divisions would be: (i) to identify and specify appropriate standards for routine maintenance works; and (ii) to commission, supervise, control and monitor these works as carried out by the maintenance works units. The intention is that the relationship between each maintenance management division and each maintenance works unit should also be governed by a 'service-level' agreement—in a form similar to a contract. Under the World Bank Highway 2 project there was technical assistance to develop client and supplier relationships for maintenance activities. This effort was taken over by the EBRD—with a detailed study completed in 2010.

24. **The ARS has a very high number of employees, which reflects the fact that maintenance is done in-house through force accounts.** The ARS has a total staff of 9,536. About 7,000 ARS staff are dedicated to road maintenance—this includes 1,180 administrative staff, 1,302 engineers, 1,697 mechanics and drivers, 4,988 labors—and 150 staff in its headquarters in Baku. The ARS is responsible for a road network of about 17,473 km. It has a ratio of 54.6 staff per 100 km, which is high as compared with more modern road agencies in transition economies that contract most of their road works.[21] The skill mix of ARS staff is considered adequate, but salaries are substantially lower than those for comparable positions in the private sector. Table 5 presents the ratio of staff per 100 km for a sample of road agencies.

[21]The World Bank technical paper 409 "Commercial Management and Financing of Roads", by Ian Heggie and Piers Vickers recommends that a fairly efficient road agency should be able to manage a network with about five or less staff per 100 km. On networks with heavy traffic, the number may rise to 10 per 100 km.

Table 5. Sample Number of Staff per100 km

Road Agency	Staff per 100 km
Lithuania	0.7
Latvia	1.5
Transit New Zealand	1.8
Finish National Road Administration	1.9
Swedish National Road Administration	2.0
South Africa ARS	2.3
Estonia ERA	3.6
Ghana Highway Authority	4.9
Colombia (INVIAS)	6.9
Slovenia	10.0
Korea Bureau of Public Roads	12.0
Indonesia (DGH)	12.5
U.K. Highways Agency	15.2
Azerbaijan ARS	54.6

Source: World Bank.

25. **There are various mechanisms available to reduce the in-house road workforce.** For example, the Estonian Road Administration was able to reduce its staff by more than two-thirds over the course of a decade: from 2,046 in 1999, to 600 in 2010.[22] In Estonia, all national road network maintenance is now contracted out to the private sector. An alternative approach would be for the private sector to take on existing staff with employment contracts for 3-5 years to utilize existing capacity and expertise. Annex 1 presents an overview of how a road agency can go from force account road maintenance to contracting through the implementation of a step-by-step approach.

26. **It is recommended that the ARS use the local road network condition survey to identify a core local road network.** The criteria used to identify core roads should include access to social services and economic centers, in order to better focus the investments in rehabilitation and maintenance (see Box 1). Core local roads are defined as roads linking villages to other villages and towns—and those short sections running through villages (i.e., the main through road). The ARS should also define a methodology to evaluate and prioritize road works on local roads. For example, a common criterion to evaluate low-volume roads is to measure the population served by each road and define priorities by maximizing the population served. Another option is to use a multi-criteria analysis that incorporates other important factors, such as the potential for economic development and access to schools and health centers.

[22] World Bank Transport Note 27 and Estonian Road Administration Annual Report 2009: www.mnt.ee/atp/failid/MNT_aastaraamat2009_eng.pdf

Box 1: Core Network of Local Roads

Worldwide experience from rural development programs and policies suggests that improving the poverty impact of rural transport infrastructure interventions requires attention to three guiding principles:

(a) An emphasis on reliable, cost-effective access for as much of the rural population as possible, rather than high access standards for a few;
(b) The use of cost-effective and innovative techniques, such as spot improvements, labor-based approaches, and low-cost structures; and
(c) A decentralized and participatory approach with strong local Government and community involvement in decision-making on local transport investments and maintenance.

Average daily motorized traffic on the majority of local roads is below 50 vehicles per day—non-motorized traffic can be a multiple of this number. Although a network of local roads, on average, constitutes about 70% of the designated network in a country, it carries only a small portion of the total traffic (10-20% of total vehicle-kilometers). Some local roads are essential for providing access to social services and economic markets—and serve a large population. It is recommended that Governments identify a network of these core local roads—based on their importance from a social and economic point of view—and ensure that the core network receives a higher level of service than the rest of the local network.

The core local road network should be identified through a participatory and interactive process—one that is both bottom-up and top-down. A national or state-based agency for rural transport infrastructure should set guidelines. However, the driving force of the process must consist of priority setting and consultations at the local Government and community levels. The process requires: (i) road network data collection and processing; (ii) preparation of accessibility indicators and maps; and (iii) a method of prioritization and data validation. Multi-criteria analysis is commonly used to rank road sections: criteria such as population served, traffic level, proximity to health and educational facilities and agricultural assets, receive weights relative to their perceived importance. The indicators must implicitly reflect economic evaluations—these evaluations, by their nature, will be quite subjective. If the weights are decided in a participatory way, the multi-criteria analysis has the potential to be a participatory planning method.

The objective is to define the network of local roads that should be maintained at a higher standard: thus, the size of the core local road network is also a function of the historically available budget and policy goals. For example, a Government could have as a goal: (i) to connect all villages at or above a certain population level with all-season roads; or (ii) to increase the Rural Access Index to a certain level. The Rural Access Index is a headline transport indicator that measures the percentage of the rural population that lives within two kilometers (typically equivalent to a walk of 20-30 minutes) of an all-season road as a proportion of the rural population.

The core local road network should be managed with support from the central Government. These roads could be completely managed by a unit of the main road administration with budget from the central Government, or they could be managed by the municipalities—with coordination and support from an entity of the central Government. In many countries, municipalities have limited capacity for managing local roads due to such factors as: (i) constrained financial resources; (ii) substantial differences in how each municipality is run; and (iii) insufficient coordination among the municipalities to work on projects that are beneficial to a group of municipalities. Thus, an entity of the central Government is needed: (i) to provide guidelines and standards; (ii) to coordinate the management activities of the network; (iii) to facilitate the channeling of financial resources for the maintenance and rehabilitation of the network; and (iv) to monitor the performance of the network.

Non-core local roads are typically comprised of very low-volume roads that connect farms and households to villages, or small villages to market centers. These roads should be managed by the municipalities or local communities using cost-effective and innovative techniques, such as spot improvements and labor-based approaches. The objective should be to ensure basic access with the lowest possible cost to as much of the population as possible. Basic access is defined as reliable all-season access for the prevailing means of transport, with limited periods of inaccessibility. Priorities could be defined by a cost-effectiveness criterion—for example, ranking roads by the direct and indirect population served by the road per the minimum investment needed to provide basic access.

Source: Jerry Lebo and Dieter Schelling (2001), Design and Appraisal of Rural Transport Infrastructure – Ensuring Basic Access for Rural Communities. World Bank Technical Paper 496. World Bank, Washington, D.C.

27. **One option is to focus on maintaining the quality of the local road network at an appropriate level within specific geographical areas, as opposed to rehabilitating a few sections of roads**. Because it has a limited budget for maintenance, the ARS needs to use the funds effectively by providing proper maintenance for the core local network. This could be implemented through PBCs which would require the contractor to be responsible for undertaking all road improvements and all routine and periodic maintenance necessary to keep the assigned road network at a specified level of service for a specified number of years. This approach would maximize the benefit to the agriculture sector and other road-users, because a larger portion of the road network would be kept at the appropriate level of service. Moreover, it would be a more efficient use of financial resources, because the contract would be designed to minimize the long-term cost of managing the local road network. Local contractors should be encouraged to participate strongly in these PBC—this would enable them to be able to invest in more efficient equipment and improve their technical expertise.

28. **Creation of a Motorway Development or Motorway Agency to manage motorways through a corridor management approach.** The Study recommends a policy approach to manage the main transport corridors—starting with the motorways—that will ensure that an entire corridor has the same level of service. The Government is particularly interested in preserving the substantial investments made in motorways and ensuring that they are operated and maintained according to international standards. At the same time, the operation of a motorway has characteristics that differ from those of other roads, and it requires different managerial skills. During the preparation of the Third Highway Project—which was financed by the World Bank—it was agreed that the Government would prepare a road investment plan and carry out a study for the creation of a Motorway Operation and Maintenance Unit under the ARS. The creation of such a unit/agency could represent the seed institution for the gradual introduction into the sector of modern techniques that could eventually be replicated for the management of the non-motorway network. In line with current thinking, the proposed agency could be a publicly-owned tolling agency.[23] The main source of funding could be tolling of the already dualized segments, to finance operation and maintenance contracts (O&Ms) with the private sector. Another option that could be considered would be availability payments for O&M concessions.

29. **Staff training.** The Azeri technical education and training system is generally considered satisfactory. However, interviews with academics indicate that the local universities need to update and modernize their teaching methods and contents, so that their graduates can be better prepared to meet the country's need to modernize its road sector.[24] In addition, there is a need for more research and development activities. A comprehensive training assessment has been carried

[23] This is the approach taken in Mexico with CAPUFE (Caminos y Puentes Federales).
[24] World Bank transport mission to Azerbaijan, September 29 to October 1, 2010.

out for ARS by FinnRoad.[25] During recent discussions with ARS management, the following topics for training were identified as priorities: (i) toll roads[26]; (ii) economic evaluation of road investments; (iii) modern design of roads and bridges; (iv) modern structural design of pavements; and (v) basic training in maintenance.

30. **Communication with road-users.** The ARS does not have a well-established system to inform citizens about road and traffic conditions—and its website does not include updated information.[27] The ARS could benefit from the experience of more developed road agencies. The UK Highways Agency, which is called Traffic England, is an example of a good communication system—it provides road-users with around the clock up-to-date traffic information on England's motorways and major roads.[28] The service is run by the National Traffic Control Centre (NTCC) of the Highways Agency.[29] The UK experience may be too sophisticated and costly for immediate implementation in Azerbaijan, but a simplified information system could be implemented in a relatively short period, which would be of considerable help to road-users.

31. **Road-user satisfaction**. Systematic surveys have not been undertaken by the ARS or the MOT to assess road-users' satisfaction—although the ARS does have a telephone number and website where users can express their opinions and complaints. There is a perception among some external stakeholders that although users may communicate to the ARS, their communications are disregarded. A number of more mature road organizations, such as the UK Highways Agency and the Swedish Road Administration, use performance management systems to demonstrate accountability to elected officials and to the public—and they periodically carry out road-user satisfaction surveys.[30] Performance management can be used by road agencies to: (i) establish goals and performance targets for managing, explaining, delivering, and adjusting their roads budgets and internal activities (Box 2); (ii) establish effective and achievable performance levels based on inputs from the public, elected officials, and the business community; and (iii) demonstrate good governance and accountability in meeting or exceeding performance expectations.[31] The ARS should consider incorporating the experiences of more mature road agencies, like those discussed above, to demonstrate accountability to the public—including periodically carrying out road-users' satisfaction surveys.

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[25] Final Training Needs Report, FinnRoad, May 2010, under World Bank financing through the Public Investment Capacity Building Project (IDA Credit 4595AZ).

[26] The MOT is considering the possibility of charging tolls on some roads—possibly by using some form of concession. The MOT considers it to be important to review models adopted in other countries and select the most appropriate model for Azerbaijan.

[27] ARS home site: http://www.georoad.ge/index.php?que=eng

[28] Traffic England home page: http://www.trafficengland.co.uk/index.aspx

[29] NTCC: http://www.highways.gov.uk/knowledge/12825.aspx

[30] UK Highways Agency Business Plan 2010-2011: http://www.highways.gov.uk/aboutus/26993.aspx. As summarized in "Linking Transportation Performance and Accountability." U.S. Federal Highway Administration. 2010. Washington, D.C. USA. http://www.international.fhwa.dot.gov/pubs/pl10009/pl10009.pdf

[31] World Bank Transport Paper No. 32, "A Review of Institutional Arrangements for Road Asset Management: Lessons for the Developing World." Cesar Queiroz and Henry Kerali. Washington, D.C. USA. http://go.worldbank.org/9XN7FBUCD0

Box 2: Key Performance Measures Used by the UK Highway Agency.

Examples of key performance measures used by the UK Highways Agency include:

a) *Road safety*: Reduce by one-third (i.e., to 2,244) the number of people killed or seriously injured on the core network by 2010 as compared with the 1994-1998 average of 3,366.
b) *Road maintenance*: Maintain the strategic road network in a safe and reliable condition—and deliver value for money—with the following targets: (i) maintain a road surface condition index of 100 ±1 within the renewal of the roads budget; and (ii) deliver selected maintenance renewals costs at an average level below inflation by the end of 2010-2011 as compared with 2009-2010.
c) *Customer satisfaction*: (i) Improve road-user satisfaction by at least 0.2 percentage points as compared with the level achieved in 2009-2010; and (ii) develop and agree upon a new customer satisfaction measure and target to be implemented for 2011-2012.

Source: UK Highway Agency.

32. **Road Safety.** The current Azeri national road safety work approach (roles, responsibilities and activities of the MOT, the ARS and other stakeholders) is not in line with international good practices. The overall approach is expected to be reviewed and revised in connection with a consultant assignment on "Azerbaijan Road Safety Program," with World Bank support. The program's main tasks include: (i) the preparation of a road safety strategy and a 5-year action plan; (ii) the design and first stage implementation of a road crash database; (iii) capacity-building, professional development, and equipment for the traffic police; and (iv) the preparation of road safety audit guidelines and guidelines for black-spot identification and treatment.

Road Maintenance and Rehabilitation

33. **Performance and Supervision.** The ARS does the quality control of road maintenance through field inspections carried out by specialized staff from its headquarters; the Road Police help in monitoring the condition of roads. For major works, the ARS contracts out supervision to outside consultants.

34. **Maintenance Standards.** Currently, there are no codified maintenance standards that are used for assessing road performance. There is no way of measuring whether the funds for maintenance are being spent efficiently, because there is no measure of outputs from the funding input. Consequently, there are no specific performance targets for road maintenance. The ARS has a mandate to keep 100% of the "strategic" road links in good condition. Regarding the remainder of the network, an effort is made to do the best with the funds available. When a road roughness survey of the network has been completed, a more objective classification of road conditions can be reported.[32] Azerbaijan has sub-optimal road maintenance due to: (i) a lack of

[32] For example, asphalt mix roads with an IRI[32] lower than 2.5 m/km are generally considered to be in very good condition; between 2.5 m/km and 3.5 m/km, in good condition; between 3.5 m/km and 5.5 m/km, in fair condition;

good technical knowledge; (ii) inadequate standards inherited from the Soviet era; and (iii) a lack of financing facilities to modernize the aging equipment fleet. Performance indicators need to be established for each asset to be contracted out through PBCs. The selection and definition of indicators should be based on: (i) road-user needs; (ii) the expectation of the client to have assets back on contract completion at a condition defined in the contract; and (iii) affordability—or the level of funding available.[33] The definition of performance indicators should be simple, clear and easy for the contractor to understand and assess.

35. Countries may adopt different institutional arrangements to manage roads, but the following trends seem to be common to those countries seeking increased efficiency and effectiveness in providing the public with an adequate road infrastructure:

a) Increased involvement of the private sector in building, maintaining, managing, operating, and financing road infrastructure; and
b) More emphasis placed on road-users and the development of methods to communicate with road-users to take into account their needs and concerns in the provision of road infrastructure.

36. **For motorways, the Study recommends O&M concessions on a pilot basis along specific road corridors**. O&M concessions are similar to maintenance PBCs, but they have longer terms—generally between 15 and 25 years. Therefore, they may include more important rehabilitation and/or upgrading works, consistent with the expected traffic growth over the longer period of the contract. They may also include broader obligations with respect to operations—including emergency, mechanical and traffic information services to road-users. These concessions may or may not include rights or obligations to charge road-user tolls. The latter may be justified where traffic volumes and users' willingness to pay tolls are sufficient to make tolling an efficient cost-recovery mechanism. A closed toll system (i.e., one in which all highway entrances and exits are controlled) allows for such optimal pricing policy, because users can be charged in accordance with the distance traveled on the toll road at rates that can be determined on the basis of the estimated long-term marginal costs of road use. An open toll system is the second best solution. Under the latter, accesses are not controlled, but toll plazas are set up on the main roadway—at distances usually ranging between 20 and 100 km—to collect a toll from every user passing through. International experience shows that road-users' willingness to pay tolls on previously toll-free roads is generally limited. However, this can be changed through effective information campaigns targeted at explaining the benefits to be derived from tolls in terms of improved road conditions and increased levels of service. It is

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between 5.5 m/km and 10.5 m/km, in poor condition; and with IRI higher than 10.5 m/km, in very poor condition. See RONET's default values in SSATP Working Paper No. 89-A, "Road Network Evaluation Tools (RONET)," Version 2.0, User's Guide, Rodrigo Archondo-Callao, January 2009, page 11.
http://go.worldbank.org/FF0CT8M770

[33] Natalya Stankevich, Navaid Qureshi, and Cesar Queiroz (2005). Performance-based contracting for Preservation and Improvement of Road Assets. Transport Note No. TN-27. September 2005 (updated August 2009). World Bank, DC. USA.

recommended that such a user survey—and also possibly an information campaign—be carried out in Azerbaijan to serve as a factor that could potentially support a Government decision on whether to introduce road tolls.

37. **Potential for Public Private Partnerships (PPPs)**. There appears to be a reasonable potential for implementing PPPs for some roads in Azerbaijan, but thus far no formal assessment of such potential has been carried out. A number of countries—for example, Brazil—have started successful PPP roads programs with road maintenance and operation toll concessions. This approach has potential in Azerbaijan.

Road Asset Management System

38. **Road Asset Management System**. Effective road asset management is dependent on the availability of information and data—this requires the use of a comprehensive computer-based system: a Road Asset Management System (RAMS). There are three key factors for a sustainable implementation of a RAMS: (i) processes; (ii) staffing; and (iii) technology (see Annex 4). In the ARS, the Road Data Management Unit (RDMU) is responsible for maintaining the road network database.

39. **Road inventory and condition survey.** As previously mentioned, the road network under the responsibility of the ARS includes a total of 17,473 km of arterial roads (M and R roads) and local roads (Y roads). The existing road classification, including the list of main and local roads, was approved by the Cabinet of Ministers in 2005—with several subsequent amendments. It is a good, logical system. However, certain roads should be reclassified after the traffic counting has been updated. In Azerbaijan, there is currently no inventory of road assets; there has been no recent road condition surveys; and there has been no systematic traffic counting. However, the ARS and its maintenance units conduct routine empirical reviews of the network. Finnroad developed a road network databank seven years ago—but it was never fully operational, due to a lack of road network data. The methodology developed at that time to evaluate the network data for strategic planning or programming of road works was never fully employed for a network evaluation. Thus, the Highway Development and Management model[34] (HDM-4) is being used in Azerbaijan only for project level evaluations.

40. **A World Bank financed consultancy signed in June 2010 is underway to collect data and establish a RAMS for the arterial and local road networks in Azerbaijan**. Under the Destia-FinnRoad contract, inventory data and road and bridge condition data are being collected—including information on road roughness and rutting. A previous attempt to establish

[34] The HDM-4 model is a modern tool for the economic evaluation of road works, and for providing support for the planning and programming of road works. It was developed from extensive research in developing countries regarding road deterioration and road-user effect. It compares project alternatives in terms of road agency costs, road-user costs and total transport costs.
http://www.hdmglobal.com/

a RAMS in Azerbaijan in 2002—under a contract with the same consultant—did not succeed.[35] Therefore, as soon as a proper RAMS has been established under the new consultancy contract, it will be critical to ensure its sustainability and full adoption by the ARS. In the first year, Destia-FinnRoad will: (i) take the inventory of all roads in the country managed by the ARS—including the collection of GPS information of the centerline of the roads; (ii) video record all roads; (iii) estimate the surface distress of the main paved roads (M and R) from the video log; (iv) measure the roughness and rut depth of the paved roads; and (v) estimate the traffic of the roads from the video log. In the second year, Destia-FinnRoad will repeat the estimation of the surface distress, and measure the roughness and rut depth of the paved roads. Road condition data will not be collected for unpaved roads[36].

41. **Recommendations to establish a sustainable road management system**. Besides managing the road network data, the RDMU shall be made responsible for evaluating the road network—this responsibility needs to be formalized within the ARS and will require adequate resources. A number of actions are required to ensure that the new RAMS works properly:

- *Establish a dedicated Road Data Management Unit (RDMU) within the ARS.* The RDMU will manage and evaluate the road network data. It should have permanent staff, a secured budget, and clear terms of reference. The unit could be located initially in the Investment Division, where there is current expertise on road network data management and evaluation. Eventually, the RDMU could be relocated to the Maintenance Division or to a newly created Planning Unit.

- *Comprehensiveness of road network database.* Ensure that a road network database and a RAMS are fully operational and able to manage all of the road network data to be collected in the future. The RAMS should have an efficient interface to the HDM-4 model and to a GIS; and it should be able to produce useful reports to support the decision-making process. In order to avoid problems faced with previous attempts to implement a RAMS, strong counterpart staff is needed to work together with consultants who will implement the new RAMS.

- *Methodology for evaluating road network data*. Ensure that a proper methodology exists to process network data for monitoring, strategic planning, programming, and economic evaluation of road works. For this purpose, the HDM-4 model—or a similar off-the-shelf model that performs a life-cycle economic evaluation of project alternatives—could be used. This would require that: (i) the RAMS was able to generate road network data files

[35] The road database established in Azerbaijan by FinnRoad in 2003 was never used in practice. A Falling Weight Deflectometer (FWD) acquired by the ARS was never properly used because of a software malfunction.
[36] In 2010, the ARS purchased 25 portable continuous traffic count stations and one Falling Weight Deflectometer (FWD).

suitable to be used by the HDM-4 for project and network level analyses; and (ii) the ARS staff was properly trained on the use of the model.

- *Methodology for evaluating and prioritizing local roads*. Define a methodology to evaluate and prioritize road works on local roads. Measuring the roughness of local roads is impractical, because they typically carry low traffic volume, and are unpaved—thus, the road condition varies greatly over time. On local roads, daily traffic is a less important factor than the roads' social functions. Therefore, other criteria related to the social function could be added to better define the relative importance of these roads. The current 2010-2011 network data collection effort is not collecting any road condition indicators for unpaved roads.

- *Define a program for network traffic data collection.* The data collection program would utilize the 25 portable continuous traffic count stations that were recently purchased by the ARS. No systematic traffic data collection program is currently being implemented in Azerbaijan. The Average Annual Daily Traffic (AADT) should be measured annually on key sections of the network in order to monitor traffic growth in different regions of the country. The ARS should make a proper characterization of the AADT and the traffic composition of each road section of the network—and update it periodically. This would require a program and methodology for annually monitoring road traffic, a properly trained ARS staff, and a sustainable budget to implement the program.

- *Measurement of pavement strength.* Define a program to use the FWD recently purchased by the ARS to characterize the pavement strength of the paved roads. Most roads in Azerbaijan were constructed using Soviet standards, and there is no knowledge of the pavement strength or the thickness of pavement layers. However, this information—for example, thickness of overlay—is critical to define the periodic maintenance needs of a road and to estimate the road deterioration with a model such as the HDM-4. A program for monthly measurements to cover the road network would enable a better use of the available FWD equipment. The characterization of the pavement strength could be done every four years—a quarter of the network every year—because deflections vary less with time, and are difficult and expensive to collect.

- *Periodic updating of vehicle fleet characteristics and road-user costs*. Define a time-bound program of actions to periodically update vehicle fleet characteristics and economic road-user costs that are needed to perform an economic evaluation of road agency alternatives. It is also necessary to define a program to periodically update the estimates of unit costs of road works in economic and financial terms.

- *Measurement of the roughness of paved roads*. Define a time-bound program of actions for sustainable measurement of the roughness of paved roads from 2012 onwards. The Study recommends that the ARS purchase one or two road roughness measurement

devices that use Laser technology in order to improve the accuracy of the results and cover all secondary roads every year.

- *Measurement of the surface distress of roads.* Define a program for sustainable measurement of the surface distress of roads—for example, cracking and potholes. Currently, no surface distress measurements are being done. The ARS should employ a methodology to assess the condition of local roads that characterizes the surface distress of M, R and Y roads. Such measurements could be done every year or every two years.

- *Provide training on an efficient RAMS to ARS staff.* The training could include the following topics: (i) road network data collection processes; (ii) network data management utilizing the road database; (iii) network evaluation for monitoring, strategic planning, programming, and economic evaluation of road works using the HDM-4; and (iv) presentation of evaluation results.

- *Developing the contents of an annual report.* Define the scope of an annual report to be prepared by the RDMU. The report should present: (i) a summary of current road and traffic conditions of the network; (ii) relevant maps; (iii) current and forecasted expenditures; (iv) monitoring indicators; (v) the expected and actual performance of the network; and (vi) the prioritized maintenance planning and budgeting programs and reports that will come from the RAMS. When a new roughness measuring device has been acquired and a road roughness survey of the network has been completed, an updated classification of road conditions could be presented in the annual report.[37]

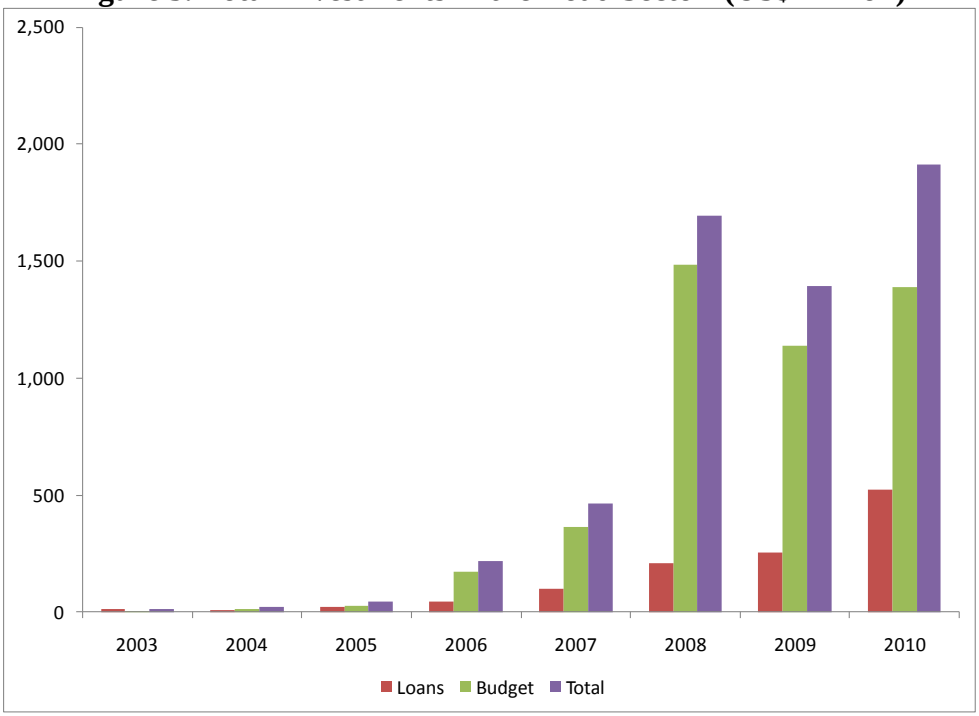
Expenditures in the Road Sector

42. **Public expenditures in the Azeri road sector, as a share of GDP, increased dramatically from 2005-09—rising threefold.** This reflects the importance of road infrastructure in the Government's strategy—and an improved fiscal situation, which makes it possible to find additional resources.[38] Table 6 provides an overview of expenditures in the road sector, and sources of financing. State investments in the sector have increased sharply, but expenditures for maintenance and rehabilitation have increased more modestly—from 0.34% of GDP in 2005, to 0.56% of GDP (US$ 243 million) in 2009. In 2009, 52% of the Road Fund was spent on routine maintenance, and 47% on periodic maintenance. In 2010, the plan was to spend 61% of the Road Fund on routine maintenance, and 39% on periodic maintenance. Figure 5 presents the total investments in the road sector from 2003-2010.

[37] For example, asphalt mix roads with an international roughness index (IRI) lower than 2.5 m/km are generally considered to be in very good condition; between 2.5 m/km and 3.5 m/km, in good condition; between 3.5 m/km and 5.5 m/km, in fair condition; between 5.5 m/km and 10.5 m/km, in poor condition; and with IRI higher than 10.5 m/km, in very poor condition.

38 During that period, IFIs also invested in road infrastructure in Azerbaijan—for example IFI funding reached US$299 million in 2008, rising to US$370 in 2009.

Figure 5. Total Investments in the Road Sector (US$ million)



43. **Azerbaijan lacks a framework from which to monitor road administration performance, budget spending, and outcomes**. There is limited information regarding: (i) the unit costs of road works; (ii) the length of maintenance and rehabilitation road works executed; and (iii) the breakdown in detail of expenditures by work activities. Road investments are exposed to the risks of over-design and inefficient use of public funds, because budget-financed operations did not require feasibility studies until recently. By contrast, IFI-financed road projects require an economic justification for all proposed investments. In early 2010, Presidential Decree 239 was issued on the Preparation and Implementation of State Investment Program—this decree requires that a feasibility study be prepared for a project. The ARS will need to strengthen its capacity in order to comply with the requirements of Presidential Decree 239 on the preparation, implementation, and monitoring of public investment projects. Preferably this responsibility should fall within the remit of the Planning Unit under the ARS.

44. **Revenue from the transport sector comes primarily from fuel excise taxes, value added taxes (VAT) on gasoline and diesel sales, and the Road Fund**. Table 7 presents the total revenues collected from various road-user charges in 2008 and 2009. The VAT on gasoline and diesel sales and the gasoline and diesel excise tax are allocated to the general budget, whereas the Road Fund revenues are allocated to the maintenance budget. The sum of the gasoline and diesel excise tax plus the Road Fund revenues came to US$690 million in 2009. This was sufficient to cover the maintenance and rehabilitation needs of the network—including

rehabilitation works. The Road Fund was reinstated in January 2007 by Presidential Decree[39] as the "Budget Fund on Roads"; it is administered by the Ministry of Finance. In 2009, the Fund received revenues of about US$ 181 million, from six sources—as shown below. In 2010, that figure was about US$213 million. In 2011, the Fund has a flat budget of US$213 million.

Table 6. Road Expenditures in Azerbaijan (US$ million)

	2005	2006	2007	2008	2009	2010
Nominal GDP	13,239	20,982	33,090	46,378	43,111	51,787
Expenditures						
New Construction, Rehabilitation and Major Repair State Investments	13	175	342	1,432	1,029	n/a
New Construction	5	154	298	1,335	967	
Rehabilitation and Major Repair	8	21	44	97	62	302
% of GDP	0.10%	0.83%	1.03%	3.09%	2.39%	n/a
Roads Fund Maintenance Expenditures	38	63	123	162	181	213
M and R Roads	15	22	71	99	96	95
Y Roads	23	40	52	63	86	117
% of GDP	0.28%	0.30%	0.37%	0.35%	0.42%	0.41%
Rehabilitation, Mayor Repair and Maintenance Expenditures	46	84	167	259	243	515
% of GDP	0.35%	0.40%	0.50%	0.56%	0.56%	0.99%

Sources: MOT and ARS

Table 7. Azerbaijan Road-user Revenues (US$ million)

	2008	2009
VAT on Gasoline and Diesel Sales	265	204
Gasoline and Diesel Excise Tax	484	509
Road Fund, including:	163	181
- Road Tax	37	45
- Vehicle Registration Fees	38	40
- Vehicle Annual License Fees	7	9
- Vehicle Import Excise Taxes	63	69
- International Transit Fees	4	4
- Cargo and Passenger Transportation Fees	14	14
Gasoline and Diesel Excise Tax Plus Road Fund	647	690

Source: ARS

45. **However, the new Road Fund does not collect revenues from a fuel tax.** This contrasts with the approach that most countries take toward Road Funds—in most cases a fuel tax is a major source of revenues. Nevertheless, the following excise rates were imposed by the Ministry of Taxes in 2010 for fuel-related revenues to be assigned to the central budget: (i) 101%

[39] It was abolished in 2001. From 1994-2000, a Road Fund formed from various road-user charges—road tax, annual vehicle inspection, vehicle sales, transit, and turnover—financed the road sector.

for motor gasoline AI-95; (ii) 92% for motor gasoline AI-92; (iii) 93% for motor gasoline AI-80; and (iv) 24% for diesel. Table 8 presents the excise fuel tax rates in different European countries. The average gasoline excise tax is 0.63 US$ per liter, while the current excise tax in Azerbaijan is about 0.26 US$ per liter. The average diesel excise tax is 0.45 US$ per liter, while the current excise tax in Azerbaijan is about 0.07 US$ per liter. The differential between the gasoline and diesel excise in Azerbaijan (4:1) is much larger than in other countries.[40] The level and structure of taxes on road transport should be governed by economic considerations relating to efficient infrastructure charging and environmental effects. This implies that road-user charges should ensure that individual travel and transport choices approximately reflect the cost that road-users impose on others over and above the private costs of operating motor vehicles.

46. **Additional potential funding from higher fuel taxes could be considered as an option—but the emphasis should be on achieving greater efficiency in road works expenditures**. The most widespread form of charging users throughout the world is through a surcharge on the consumption of fuel, because it relates to road usage, is easily recognizable, and is simple to administer. According to a recent report by the GTZ, on a global average, some 80-90% of all transport sector revenues are raised via fuel taxes.[41] Fuel prices in Azerbaijan, at US$75 cents per liter for gasoline and US$56 cents for diesel, are significantly lower than similar countries in the region. Fuel prices in Azerbaijan are lower than in Russia, but higher than in Kazakhstan. Table 9 shows that there are countries in Europe with comparable GDP per capita levels and higher fuel prices. This suggests that there is significant room for additional funding from fuel levies—even taking into account affordability considerations. A detailed analysis on all road taxes should be conducted to properly compare Azeri road taxes with those of similarly positioned countries, and to consider other details such as indexation for inflation.

[40] Presumably, this reflects the Government's concern about the impact of high diesel excises on the cost of industry and agriculture—and perhaps more importantly, on the use of diesel fuel in commercial vehicles. Although there is no justification for imposing revenue-raising excises on the intermediate uses (inputs to production) of diesel, diesel-powered commercial vehicles should always bear appropriate externality-correcting taxes, because the latter should be passed on in price if the fuel excise is to perform its economic role. Diesel-powered vehicles emit particulates—for example, soot—that cause health problems (respiratory ailments and cancer), particularly in urban areas. Although the picture is complicated, on balance the differential excise duty in favor of diesel fuel is inconsistent with the relative environmental damage caused by diesel engine versus gasoline engine vehicles. Beyond this, the fact that diesel engines are more fuel-efficient per kilometer than gasoline engines indicates that—per liter of fuel—diesel-powered trucks impose more damage on roads than gasoline-powered trucks. Thus, diesel should be taxed at a higher rate than gasoline. Admittedly, diesel oil is often used by buses, which provide transportation for the poor, but the impact of a higher excise on fares would be so small that it would have a negligible effect on the cost of transportation for any individual passenger.

[41] GTZ (2009), *International Fuel Prices 2009.* Available at: http://www.gtz.de/de/dokumente/gtz2009-en-ifp-full-version.pdf.

Table 8. Excise Fuel Tax (US$/liter)

	Gasoline	Diesel
Armenia	0.31	0.09
Austria	0.46	0.33
Azerbaijan	**0.26**	**0.07**
Belgium	0.61	0.36
Czech Republic	0.81	0.68
Denmark	0.45	0.30
France	0.66	0.47
Georgia	0.26	0.16
Germany	0.70	0.50
Greece	0.43	0.35
Hungary	0.82	0.68
Ireland	0.44	0.36
Italy	0.67	0.48
Korea	0.94	0.60
Netherlands	0.73	0.40
Norway	0.51	0.36
Portugal	0.29	0.17
Slovak Republic	0.90	0.84
Spain	0.52	0.38
Turkey	1.75	1.07
United Kingdom	0.76	0.76
Average	**0.63**	**0.45**

Sources: World Bank; OECD 2005.

47. **The Road Fund is channeling revenues to road maintenance**.[42] Whatever amount is collected as revenue for the Fund is earmarked for road maintenance and road repairs.[43] During the budgeting process, the amount to be collected is estimated, but the amount released to the Fund equals actual revenue collected shown as a single line item.[44] The ARS requests and justifies funding needs for maintenance and remedial works. The criteria for allocating Road Fund money are determined by the Cabinet of Ministers, and subsequently approved by the President. Typically, about 50% of the revenue is allocated to arterial roads, 37% to local roads, and 12% to urban roads. The ARS selects specific geographic areas, road segments, and work-type distribution for maintenance funds and—if needed—changes or reallocates funds during the budget year.

[42] Project Appraisal Document of Azerbaijan Third Highway Project financed by the World Bank.

[43] What constitutes 'road maintenance' and 'road repairs' is not defined.

[44] Maintenance budget allocations are not fixed in the Government budget; the total amount for maintenance and repairs is one line item. The annual Project list is usually approved in February/March of the same year; typically, it is not publicly disclosed.

Table 9. Gasoline and Diesel Prices (US cents per liter, unless otherwise stated)

	Gasoline	Diesel	GDP Per Capita (US$ dollars)
Albania	146	140	3,616
Armenia	108	99	2,677
Azerbaijan	**75**	**56**	**5,765**
Bosnia and Herzegovina	142	142	4,158
Bulgaria	151	158	5,955
Czech Republic	175	169	18,722
Georgia	113	113	2,560
Germany	190	168	40,512
Hungary	167	161	13,210
Kazakhstan	71	51	8,327
Moldova	121	108	1,503
Netherlands	213	171	46,418
Poland	157	150	11,522
Romania	146	146	7,391
Russian Federation	84	72	10,522
Serbia	150	148	5,262
Slovak Republic	170	153	15,906
Turkey	252	203	10,207
Ukraine	101	92	3,003
United Kingdom	192	198	36,298

Note: Retail prices as of November 2010, when crude oil prices were US$81/bbl BRENT. This is equal to 51 US cents per liter.

Sources: GIZ available at www.gtz.de/fuelprices; IMF, World Economic Outlook, October 2010.

Box 3: Setting the Level of Taxation for Road-users

Excises on motor fuel and motor vehicles can be rationalized as proxies for the cost of government-provided road services. Road and transport services resemble goods produced in the private sector that are used optimally when their price—commonly referred to as the economic-user charge—equals the total social costs of constructing and operating the road network. The social costs of road transport include the following categories:

- Physical wear and tear caused by motor vehicles using the roads: fuel and license fees, particularly for heavy trucks, can be designed to charge users for these costs.
- Environmental costs on account of air pollution: urban lead that harms health, nitrogen oxides that contribute to acid rain, and carbon dioxide that causes global warming. (Differentiated) fuel excises are the most suitable instrument for charging road-users for air pollution costs.
- Injury and property costs due to traffic accidents. (Probably the best instrument is a tax on car insurance premiums).
- Congestion costs in urban environments, where nearly 60% of the country's inhabitants reside. Usually, this is the subject of regulation rather than taxation.

There is little doubt that developing countries should raise taxes on road transport to reflect the social costs of road use. Beyond this, the case for using road transport for revenue-raising purposes—over and above the social costs—could be strong for Georgia and Armenia, because the economic and administrative costs are lower than for other taxes. The distortionary impact on private sector activity tends to be limited. However, in the absence of a detailed examination of the social costs of road use and an evaluation of the difficult trade-offs and compromises needed in view of the multiplicity of objectives, it is difficult to provide specific recommendations regarding the extent to which the taxation of road transport should be increased. Basically, the Study's analysis can be used as a starting point for further discussion and research.

Adapted from the World Bank Report on Tax Policy in Kazakhstan (2007)

48. **The Study recommends that the Road Fund should collect all funds needed for periodic and routine maintenance works on all inter-urban roads and some urban roads**. Because there is a large backlog of deferred maintenance in Azerbaijan, rehabilitation expenditures could be financed through: (i) general tax revenues; (ii) donor-financed loans or grants; or (iii) Road Fund revenues. In the short-term, general tax revenues or donor-financed loans or grants could be used. However, financing through donor-financed loans or grants is not sustainable in the long–term, because the Government will not be able to continue servicing donor-financed road rehabilitation programs from tax revenues and donor-financing will eventually cease. If rehabilitation works must be financed through the Road Fund—which is not recommended—funds for rehabilitation should be clearly designated as a temporary surcharge. Currently, rehabilitation works are being financed by general tax revenues. If increasing Road Fund revenues is needed, the Study recommends including fuel taxes in the revenues allocated to the Fund, because they relate to road usage, are easily recognizable, and are simple to administer.[45] Moreover, as shown above, the current excise rates on gasoline and diesel are lower in Azerbaijan than in most European countries—and fuel prices are significantly lower.

C. Maintenance and Rehabilitation Requirements on the ARS Road Network

49. **The World Bank has undertaken an assessment of the required expenditure levels for the maintenance and rehabilitation of M, R and Y roads, in order to compare these with actual and projected expenditures**. The HDM-4 model (see Box 3) was used to evaluate the performance of the roads managed by the ARS under several maintenance and rehabilitation standards. The HDM-4 evaluation of network strategies provided indicative figures of the maintenance and rehabilitation needs of the network. It was an example of the type of evaluation that should be undertaken by the ARS when developing its annual business plans. To obtain more precise results, the Study recommends that this type of network strategic evaluation be repeated in the near future using the network data being collected. This refined network strategy evaluation should include an estimation of the network maintenance, rehabilitation and development needs—such as capacity improvements.

[45] The key principles for making commercially-managed road funds viable are as follows: (i) the introduction of the road fund should be part of a wider agenda to commercialize road management; (ii) only road-user charges should be paid into the road fund; (iii) the arrangement must not abstract revenues from other sectors; and (iv) the road fund should be overseen by a representative public sector board and managed by a strong and independent secretariat. There is a need to avoid four generic problems: (i) difficulties collecting the revenues attributable to the road fund; (ii) the making of unauthorized withdrawals from the road fund—normally referred as "raids"; (iii) payments for goods and services that are either substandard or have never been delivered; and (iv) poor financial management of the accounts.

Box 3: Highway Development and Management Model (HDM-4)

The Highway Development and Management Model (HDM-4) simulates total life-cycle conditions and costs for one road, a group of roads with similar characteristics, or an entire network of paved or unpaved roads, for a series of road agency construction or maintenance standards—and it provides the economic decision criteria for evaluating the standards being analyzed. The primary costs computed for the life-cycle analysis include the costs of road construction and maintenance and vehicle operating costs—to which travel time costs and accidents can be added. The costs of construction-related traffic delays and environmental pollution can be entered in the model exogenously, based on separate estimates. The HDM-4 contains a budget constraint optimization module, to find the best way of using road agency funds under budgetary constraint.

The broad concept of the HDM-4 model is quite simple. The process starts with a given road and a given series of user-specified road agency standards. Three interacting sets of costs (related to the construction, maintenance and road-users) are added together over a defined evaluation period in discounted present values. This is used to compute the present value of total transport costs, where costs are determined by first predicting physical quantities of resource consumption and then multiplying these by unit costs or prices. The economic benefits are then determined by comparing the total transport costs for the each of the standards with a base standard (null alternative), which usually represents minimal routine maintenance. The optimal standard is the one with lower total transport costs or higher net benefits compared with the base standard. The user obtains net present values, rates of return, and other economic indicators needed to compare the standards and prioritize road works.

Therefore—within the planning, budgeting and programming functions of a highway agency—the HDM-4 model may be used to establish:

- Desired budget levels that would minimize the total costs of road transportation;
- Appropriate policies and standards for construction and maintenance programs that are consistent with minimizing total transport costs under existing resource constraints;
- Long- and medium-term investment and maintenance programs; and
- Appropriate, economically derived intervention criteria to develop short-term programs and annual budgets—based on an appropriate pavement management system.

The model contains road deterioration, road works effects, and road-user costs relationships derived from extensive research done in developing countries over the past 30 years—research that was carried on collaboratively by the World Bank and major research institutions and highway administrations. An important feature of the model is the analytical support it can provide to make a convincing case to legislatures and top decision-makers for adequate maintenance funding to preserve the road infrastructure.

50. **The HDM-4 assessment was based on a number of assumptions, and three different options**. The basic assumptions included: (i) a 5% traffic growth rate per year; (ii) a 12% discount rate; (iii) a 20-year evaluation period; (iv) unit costs of road works based on current average road work costs in Azerbaijan; and (v) average unit road-user costs based on current average vehicle fleet characteristics in Azerbaijan. The three different options were as follows: (i) minimize total transport costs scenario; (ii) expenditures of US$243 million per year scenario; and (iii) keep current road condition scenario. The options presented in this section are for expenditures on M, R and Y roads:[46]

- *Option 1 - Minimize total transport costs.* This scenario selects the maintenance standard per road class that minimizes the present value of road agency costs plus road-user costs over the evaluation period. It achieves a target of 83% of roads in good or fair condition by 2020. It is estimated that the rehabilitation backlog would be addressed within 5 years;

[46] Further details can be found in Annex 6.

- *Option 2- Expenditures of US$243 million per year*. This scenario exemplifies current road maintenance and rehabilitation expenditures in Azerbaijan, at US$243 million annually. This scenario takes into consideration maintenance and rehabilitation expenditures on the network from 2005 to 2011, with 77% of roads in good or fair condition by 2020; and

- *Option 3- Keep current road condition*. This scenario takes into consideration the current condition of the road network and assumes that this condition will be maintained in the future. Under this scenario, 39% of roads would be in good or fair condition in 2020.

- **The Study argues that the ARS should aim at eliminating the rehabilitation backlog by at least maintaining the current level of rehabilitation and maintenance expenditures, i.e. Option 2.** Table 10 presents the results of the model. It shows that annual expenditures should be US$243 million for the first five years for Option 2, which corresponds to the 2009 ARS expenditures on rehabilitation and maintenance works. These expenditures will bring the percentage of the network in good or fair condition to 77% by 2020, which is satisfactory. To achieve the minimum total transport costs scenario, US$288 million annually would be needed for the next five years. This is the optimal scenario from an economic point of view, but it would only marginally increase the percentage of the network in good or fair condition by 2020 to 83%, as compared with 77% for Option 2.

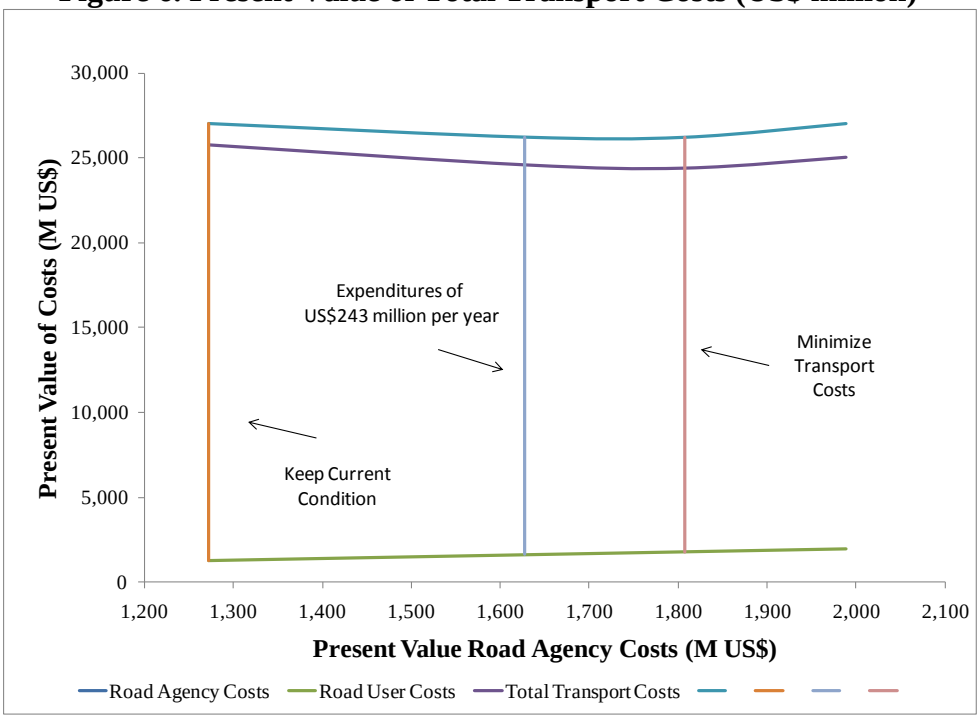
Table 10. Required Expenditures on ARS Roads
(US$ million, unless otherwise indicated)

	Roads in Good or Fair Condition in 2015 (percentage)	Roads in Good or Fair Condition in 2020 (percentage)	Annual Expenditures for First 5 Years	Annual Expenditures for Next 15 Years	Present Value of Expenditures Over 20 Years	Financing Gap in First 5 years
Option 1	80	83	288	136	1,808	45
Option 2	**73**	**77**	**243**	**142**	**1,627**	**0**
Option 3	38	39	162	121	1272	-81

Source: World Bank staff estimates

51. **Present value of total transport costs.** Figure 6 shows the present value of road agency costs, road-user costs, and total transport costs (sum of road agency and road-user costs) over the evaluation period, at a 12% discount rate, for the three different expenditure options. Although the ARS would spend less keeping the current road condition, total transport costs would be higher. The optimal option would be the minimize transport cost scenario (Option 1). However, the budget-constrained scenario that would require expenditures of US$243 million annually (Option 2) would lead to significantly better road conditions than what could be achieved under the keep current road condition scenario (Option 3). In all three options, road-users would bear the bulk of transport costs—through vehicle operating costs. In comparison with Option 3, the ARS would increase the present value of road expenditures by US$355 million if it were to opt for Option 2. However, this decision would be beneficial for road-users, because every dollar the road agency spends under this scenario would decrease road-user costs by 3.3 times. This provides a strong argument for increasing expenditures, because the benefits in terms of reduced road-user costs would exceed the additional expenditures required.

Figure 6. Present Value of Total Transport Costs (US$ million)

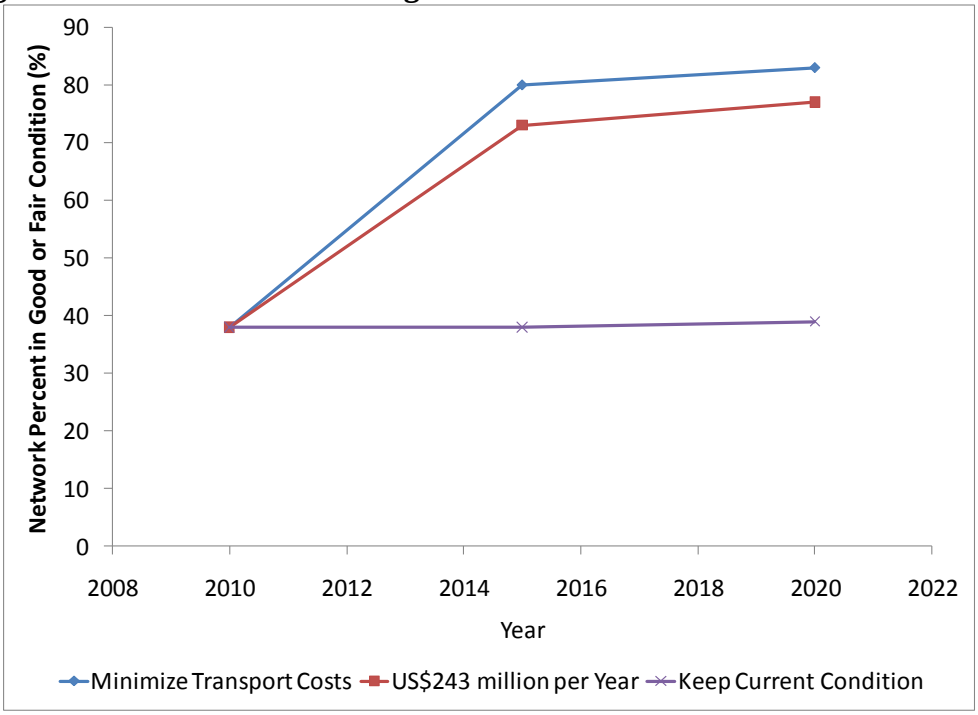


Source: World Bank estimates.

52. **Network condition and asset value.** Different levels of expenditure over a number of years would clearly have an impact on the condition of the road network. Figure 7 presents the impact of the three different options on the road network condition in 2015 and 2020. Only 38% of ARS roads were in good or fair condition in 2010. By 2015, this would rise to 83% under the minimize total transport costs scenario, and 77% under the expenditures of US$243 million per year scenario. The current road asset value is US$7,037 million. By 2015, that would rise by

18% to US$8,243 million under the minimize total transport cost scenario, and by 16% to US$8,136 million under the expenditures of US$243 million per year scenario. The keep current condition option would maintain the current asset value.

Figure 7. ARS Roads – Percentage of the Network in Good or Fair Condition



Source: World Bank estimates.

53. **The amount of funds dedicated to the road sector, if used wisely, could be sufficient to bring the whole ARS network into a maintainable condition**. In 2008, the Government spent US$259 million on rehabilitation, periodic maintenance and routine maintenance; in 2009, that figure was US$243 million (see Table 6). This is less than what would be required under the minimize total transport costs scenario—US$281 million per year. However, the planned 2010 expenditures of US$515 million for rehabilitation, periodic maintenance and routine maintenance would exceed the amount required under the minimize transport costs scenario. This suggests that a sufficient amount of resources are being allocated for maintenance and rehabilitation works. However, as shown in Table 11, there is a difference between the optimal allocation of resources estimated by the HDM-4, and the ARS expenditures. In 2010, the ARS allocated around US$20,000 per km for routine and periodic maintenance for the M and R roads, and around US$8,900 per km for the Y roads—these are high values based on international experience. The high level of ARS expenditures on routine and periodic maintenance is an indication that: (i) many resources are being spent for emergency works on roads in poor condition—which would not be needed if the rehabilitation backlog was eliminated and a periodic maintenance program was implemented, and (ii) higher efficiency could be obtained if routine maintenance works were contracted out to the private sector.

Table 11. Comparison between the HDM-4 Estimate and ARS Expenditures

	HDM-4 Estimate		2009 Expenditures		2010 Planned Expenditures	
	(US$ million)	(%)	(US$ million)	(%)	(US$ million)	(%)
Routine Maintenance	55	19%	95	39%	132	26%
Periodic Maintenance	59	21%	86	36%	80	16%
Rehabilitation	174	60%	62	25%	302	59%
Total	288	100%	243	100%	515	100%

Source: World Bank estimates.

54. **The future financing plans for the road sector should take into account four main objectives**. These are as follows:

a) Maintain a level of maintenance and rehabilitation expenditures of around US$300 million per year over the next five years;
b) Improve the cost effectiveness of maintenance and rehabilitation expenditures by contracting out maintenance and rehabilitation works;
c) Incorporate within the road sector the macroeconomic constraints consonant with a future of declining oil reserves—and develop a network consonant with the projected non-oil GDP. This would require strengthening the Road Fund to secure funding for maintenance and rehabilitation works—and performing the economic evaluation of development works based on realistic traffic projections; and
d) Emphasize institutional development by starting with the aim of protecting current assets and the substantive investments in motorways—and achieve better efficiency on maintenance and rehabilitation works expenditures by implementing more cost-effective contracting practices.

D. Conclusions

55. **The condition of the majority of the road network remains poor, reflecting the poor condition of local roads.** The Study found that transport costs were high and connectivity to markets poor due to degraded rural infrastructure. Over 60% of arterial roads are in good or fair condition—this is true of only 29% of local roads. This reflects under-spending on local roads, as the Government has prioritized expenditures on arterial roads—which represent 27% of the network, and carry 90% of the road traffic. The current asset value of the entire road network is estimated to be US$1.3 billion less than what it would have been if there had been proper maintenance in recent years.

56. **The World Bank has undertaken an assessment of required expenditure levels for the maintenance and rehabilitation of all road categories.** The Highway Development and Management Model (HDM-4) was used to measure the performance of roads managed by the ARS under several maintenance and rehabilitation standards. Based on a detailed assessment of

the functioning of the ARS and road sector expenditure levels and road sector outcomes, the Study makes a series of recommendations. These are detailed below:

Recommendations

57. **Road network**. The study makes the following recommendations regarding the road network:

- *Road design standards.* Much of the road network in Azerbaijan now sustains traffic from a much higher number of much larger trucks with European dimensions—which is compounded by trucks overloading. The inappropriateness of the old designs for the new demands being made on them is restraining economic and social growth. Pavement standards in Azerbaijan are not based on equivalent standard axle (ESA), which requires factoring in forecast traffic demand over the design life to determine pavement strength.[47] The ARS should review and adopt the recommendations of a study on road design standards expected to be completed by the end of 2011;

- *Review of design standards for local roads.* The design standards used to rehabilitate local roads are often higher than justified by the level of traffic. Therefore, the limited financial resources are allocated to the rehabilitation of a few segments of roads without improving the overall quality of the network—and this winds up increasing total transport costs. Over-designed standards penalize road-users in the long-run; and

- *Increase the capacity of some roads*. Because vehicle ownership is expected to continue growing going forward, there is a need to increase the capacity of some roads by widening them to four lanes. This is also justified by the high accident rates of two-lane roads in Azerbaijan.

58. **Institutional setup.** There are a number of issues with regard to the existing organizational structure of the ARS—particularly with regard to road maintenance. The study recommends the following:

- *Strengthen the Planning Unit*. The ARS should support the Planning Unit and use road condition surveys to monitor the network and plan maintenance. The planning unit should evaluate the preservation and development needs of the network. It should also house the Road Data Management Unit (RDMU), for managing the RAMS;

- *Create a Motorway Unit within ARS or a separate Motorway Agency*. The motorway management is deficient—it could be strengthened either by the establishment of a Motorway Unit within the ARS or through a separate Motorway Agency. The Motorway

[47] In the EU and the US, the crucial factor in the design of a pavement is the Equivalent Standard Axle (ESA), which involves converting the traffic demand forecast into an estimate of ESAs over the design life to determine pavement strength.

Operation and Maintenance Component of the World Bank-financed Third Highway Project will enable the ARS to consider different management options for motorways, and implement the most appropriate one for Azerbaijan;

- *Move towards road maintenance contracting.* The Government should gradually start to use the private sector for road maintenance activities. It should transform the in-house labor for road maintenance into road maintenance enterprises—under a well structured plan that might entail the restructuring of the regional road maintenance units. During a transition period—with an aim towards the separation of Client and Supplier functions to improve efficiency—the ARS could set up regional maintenance management ('client') divisions to be functionally separate from the existing maintenance works units ('suppliers'). This would reduce the number of staff as the ARS moved gradually away from force account maintenance.

- *Identify a core network of local roads.* The ARS should use the road network condition survey to identify a core network of local roads. On local roads, daily traffic is a less important factor than the roads' social functions. Therefore, the criteria used to identify core roads should include access to social services and economic centers, in order to better focus the investments in rehabilitation and maintenance. Once the core network has been defined, the ARS should focus on maintaining the quality of the core local road network at an appropriate level within specific geographic areas, instead of the current practice of rehabilitating a few sections of local roads.

- *Develop a motorway corridor management approach.* The ARS should adopt a policy of managing the main transport corridors—starting with the motorways—to ensure that the same level of service is maintained throughout an entire corridor. The Government is particularly concerned with preserving the substantial investments made in motorways, and ensuring that they are operated and maintained according to international standards.

- *Enhance staff training program.* The ARS considers training in procurement—particularly international procurement—and contract monitoring to be of the highest priority. Other priority topics for training include road safety audits, PBCs, and bridge management systems. There is also a need to enhance the training of engineering students with regard to road maintenance and construction, so that they will be prepared for working with the public and private sectors.

- *Introduce a simplified information system aimed at enhancing communication with road-users*. This system could be implemented in a relatively short period—and it would be of considerable help to road-users; and

- *Introduce systematic surveys to assess road-users' satisfaction*. The ARS should also introduce a performance management system to demonstrate accountability to elected officials and to the public.

59. **Road maintenance and rehabilitation.** As already discussed in the previous section, one of the Study's key recommendations is to move away from force account road maintenance to traditional contracting and/or PBCs. The implementation of a contracting approach would require the following:

- *Define road maintenance standards and performance indicators*. Currently there are no codified maintenance standards that are used for assessing road performance. Consequently, there are no specific performance targets for road maintenance. Performance indicators need to be established for each asset to be contracted out under PBCs. The selection and definition of indicators should be based on: (i) road-user needs; (ii) the expectation of the client to have assets back on contract completion at a condition defined in the contract; and (iii) affordability—or the level of funding available. The definition of performance indicators should be simple, clear and easy for the contractor to understand and assess.

- *Introduce of O&M concessions on a pilot basis along specific road corridors.* O & M concessions are similar to performance-based maintenance contracts, but they have longer terms—generally between 15 and 25 years. Therefore, they may include more important rehabilitation and/or upgrading works—consistent with the expected traffic growth over the longer period of the contract. They may also include broader obligations with respect to operations, including emergency, mechanical and traffic information services to road-users.

60. **Road Asset Management System (RAMS).** The following actions are required to ensure that a new RAMS will be successful:

- *Establish a dedicated Road Data Management Unit (RDMU) within the ARS to manage and evaluate the road network data.* The RDMU should have permanent staff, a secured budget, and clear terms of reference. The Unit can initially be located initially within the Investment Division, where there is current expertise on road network data management and evaluation. Eventually, it can be relocated to the Maintenance Division or a newly created Planning Unit.

- *Comprehensiveness of road network database.* Ensure that a road network database and a RAMS are fully operational and able to manage all of the road network data to be collected in the future. The RAMS should have an efficient interface to the HDM-4 model and to a GIS; and it should be able to produce management reports to support the

decision-making process. In order to avoid problems faced with previous attempts to implement a RAMS, strong counterpart staff is needed to work together with the consultants who will implement the new RAMS;

- *Methodology for evaluating road network data*. Ensure that a proper methodology exists to process network data for monitoring, strategic planning, programming, and economic evaluation of road works. For this purpose, the HDM-4 model—or a similar off-the-shelf model that performs a life-cycle economic evaluation of project alternatives—could be used. This would require that: (i) the RAMS was able to generate road network data files suitable to be used by the HDM-4 for project and network level analyses; and (ii) the ARS staff was properly trained on the use of the model;

- *Methodology for evaluating and prioritizing local roads*. Define a methodology to evaluate and prioritize road works on local roads. Measuring the roughness of local roads is impractical, because they typically carry low traffic volume, and are unpaved—thus, the road condition varies greatly over time. On local roads, daily traffic is a less important factor than the roads' social functions. Therefore, other criteria related to the social function could be added to better define the relative importance of these roads. The current 2010-2011 network data collection effort is not collecting any road condition indicators for unpaved roads.

- *Define a program for network traffic data collection.* The data collection program would utilize the 25 portable continuous traffic count stations that were recently purchased by the ARS. No systematic traffic data collection program is currently being implemented in Azerbaijan. The Average Annual Daily Traffic (AADT) should be measured annually on key sections of the network in order to monitor traffic growth in different regions of the country. The ARS should make a proper characterization of the AADT and the traffic composition of each road section of the network—and update it periodically. This would require a program and methodology for annually monitoring road traffic, a properly trained ARS staff, and a sustainable budget to implement the program.

- *Measurement of pavement strength.* Define a program to use the FWD recently purchased by the ARS to characterize the pavement strength of the paved roads. Most roads in Azerbaijan were constructed using Soviet standards, and there is no knowledge of the pavement strength or the thickness of pavement layers. However, this information—for example, thickness of overlay—is critical to define the periodic maintenance needs of a road and to estimate the road deterioration with a model such as the HDM-4. A program for monthly measurements to cover the road network would enable a better use the available FWD equipment. The characterization of the pavement strength could be done every four years—a quarter of the network every year—because deflections vary less with time, and are difficult and expensive to collect.

- *Periodic updating of vehicle fleet characteristics and road-user costs*. Define a time-bound program of actions to periodically update vehicle fleet characteristics and economic road-user costs that are needed to perform an economic evaluation of road agency alternatives. It is also necessary to define a program to periodically update the estimates of unit costs of road works in economic and financial terms;

- *Measurement of the roughness of paved roads*. Define a time-bound program of actions for sustainable measurement of the roughness of paved roads from 2012 onwards. The Study recommends that the ARS purchase one or two road roughness measurement devices that use Laser technology in order to improve the accuracy of the results and cover all secondary roads every year;

- *Measurement of the surface distress of roads.* Define a program for sustainable measurement of the surface distress of roads—for example, cracking and potholes. Currently, no surface distress measurements are being done. The ARS should employ a methodology to assess the condition of local roads that characterizes the surface distress of M, R and Y roads. Such measurements could be done every year or every two years;

- *Provide training on an efficient RAMS to ARS staff.* The training could include the following topics: (i) road network data collection processes; (ii) network data management utilizing the road database; (iii) network evaluation for monitoring, strategic planning, programming, and economic evaluation of road works using the HDM-4; and (iv) presentation of evaluation results; and

- *Developing the contents of an annual report.* Define the scope of an annual report to be prepared by the RDMU. The report should present: (i) a summary of current road and traffic conditions of the network; (ii) relevant maps; (iii) current and forecasted expenditures; (iv) monitoring indicators; (v) the expected and actual performance of the network; and (vi) the prioritized maintenance planning and budgeting programs and reports that will come from the RAMS. When a new roughness measuring device has been acquired and a road roughness survey of the network has been completed, an updated classification of road conditions could be presented in the annual report.

61. **Expenditures in the road sector.** Azerbaijan currently lacks a framework from which to monitor road administration performance, budget spending, or outcomes. In addition, the Azeri Road Fund currently does not receive any funds originating from fuel taxes. With these factors in mind, the Study recommends the following:

- *Enhance the capacity to commission and review feasibility studies*. The ARS will need to strengthen its capacity to comply with Decree 239—which requires feasibility studies for all investments—by commissioning and reviewing studies, and by supervising consultants who would put together feasibility studies and cost benefit evaluations.

Preferably this responsibility should fall within the remit of the Planning Unit under the ARS.

- *Consider the option of increasing fuel levies and including these additional revenues within the Road Fund, because they relate to road usage, are easily recognizable, and are simple to administer*. This recommendation reflects the view that: (i) the Road Fund should collect all funds needed for routine and periodic maintenance for all inter-urban roads and part of the urban road network; and (ii) the overall Road-user charges should cover operation, maintenance and depreciation of the roads, as well as environmental and other social costs.

- *Prepare future financing plans for the maintenance and rehabilitation of the road network*. Future financing plans for the road sector should take into account four main objectives. These are as follows:

  a) Maintain for the upcoming five years a level of maintenance and rehabilitation expenditures of around US$288 million per year—which is the option that minimizes total transport costs;

  b) Improve the cost-effectiveness of maintenance and rehabilitation expenditures by contracting out maintenance and rehabilitation works;

  c) Incorporate within the road sector the macroeconomic constraints consonant with a future of declining oil reserves—and develop a network consonant with the projected non-oil GDP. This would require strengthening the Road Fund to secure funding for maintenance and rehabilitation works—and performing the economic evaluation of development works based on realistic traffic projections; and

  d) Emphasize institutional development by starting with the aim of protecting current assets and the substantive investments in motorways—and achieve better efficiency on maintenance and rehabilitation works expenditures by implementing more cost-effective contracting practices.

Annex 1. Transforming Force Account Road Maintenance to Contracting

This annex presents how a road agency can transform force account road maintenance to contracting.[48] The steps to transform force account to contracting are the following: (i) situation analysis; (ii) constraint analysis; (iii) identification of options; (iv) development of transformation strategy and action plan; (v) attention to social issues; (vi) implementation; and (vii) establishment of monitoring and control.

Situation Analysis. The first task for the road agency is to prepare some basic statistics on the sector in order to set the context, scope and scale of the transformation. These figures provide the basis for assessing the demand for road services. Also required is data on current capacity in terms of staff numbers and skills, and equipment holdings, for both the private and public sectors. The road agency needs to evaluate strategies and policies in regard to management and financing of roads, network development, removal of backlog, and maintenance. The agency then should carry out an analysis to determine whether these strategies, policies and legislation are adequate, and to what degree they are being implemented or enforced.

Constraint Analysis. A gap will often emerge between the demand for road maintenance services and the current capacity for delivering them. This may be manifested in terms of a need to upgrade Government policies and legislation, a shortfall in the ability of the Government to administer the services, and/or a shortfall in the capacity of the private sector to deliver the services. Once these gaps and constraints are identified, various options can then be considered to remove them.

I**dentification of Options.** Following the carrying out of the situation and constraint analyses and the setting up of a transformation team, the Government should then determine how far it desires the transformation to go. A functional analysis should be undertaken addressing the following questions: (i) what existing functions are in place; (ii) what functions will need to be retained and developed within the public sector; (iii) what new functions will need to be added to public sector; (iv) what new functions will need to be implemented by the private sector; and (v) what existing functions will be switched to the private sector. The decision to transform force account has profound implications on the public sector organizations managing the road sector. Much of the work will now be out-sourced; therefore, the required staffing levels will be reduced for operational/execution functions and those staff that remain will need a different set of skills. Hence, one of the first strategic decisions to be made is to determine what sort of institutional

[48] This annex extracted from World Bank Technical paper 11 "How a Road Agency Can Transform Force Account Road Maintenance to Contracting" by Adam Andreski, Subhash Seth and Wendy Walker. June 2006. http://go.worldbank.org/6HDCYBMRT0

structure should administer the road sector, and what existing government structures need to be strengthened at the various levels for contract management.

Once the institutional structure has been established, plans should be put in place to handle the personnel implications. A number of options need to be considered that take into account both financial and human resource factors. These options may include: (i) recruiting chief executive using transparent criteria; (ii) transferring staff to autonomous agencies or local councils; (iii) transferring staff to a Government-formed road contractor or contractors; (iv) seconding Government staff to contractors or consultants; (v) transferring staff from central government to local government; and (vi) privatizing or commercializing particular elements of the organization. Having considered the options for staff transfers, some may then become redundant, and funded plans need to be put in place. The options here include: (i) voluntary redundancy; (ii) retrenchment; (iii) natural wastage; (iv) temporarily reduced retirement age; (v) training support; and (vi) attrition—or doing nothing. The most important consideration is staffing, but it is also important to avoid wasting other resources, such as the plant environment and equipment.

A number of options on how to handle Government-owned plants include: (i) transferring equipment to State-owned company; (ii) transferring equipment to Government-owned plant hire/leasing centre; (iii) selling equipment; (iv) including equipment as assets that contractors bid for as part of road works tenders; and (v) doing nothing—or attrition.

A number of options on how to better phase in contracting include: (i) letting the private sector respond on its own; (ii) packaging contracts as a way of providing work for the spectrum of the local construction industry; (iii) setting up a National Construction Council (NCC) to develop contractors; (iv) regulating contractors through a registration system; (v) facilitating the creation and operation of contractors associations; (vi) providing subsidized plants and equipment to contractors; and (vii) training contractors.

Development of a Transformation Strategy and Action Plan. Next, the road agency should draft a transformation strategy and action plan based on the options chosen during the previous step. This should be time bound—around 3-10 years—with costs and identified responsibility for implementation. A Transformation Project Team should be set up to manage the process in the ministry or agency responsible for roads. The strategy should have a vision of where the transformation should be at the end of the chosen time-frame. Strategic objectives should then be set. This would include: (i) the type of national and local road administrations to manage the network; and (ii) the size and structure of the road contracting industry appropriate to maintain and develop the network. Such a plan must be realistic and achievable—it must take into account the economy of the country and the anticipated demand for road transport services. A broad financial envelope should be established using asset management principles.

Attention to Social Issues. The transformation from force account to private contracting can have negative impacts on workers because of the need for redundancy or retrenchment—but these impacts should be anticipated, and can be mitigated. At the same time, the transformation also provides numerous opportunities for poverty alleviation through: (i) labor-based techniques and gender mainstreaming; (ii) the use of social and environmental clauses in contracts; and (iii) attention to HIV/AIDS outreach and awareness among workers and communities adjacent to the civil works. One of the keys to the success of force account transformation is proper attention to and planning for mitigation of the impacts on affected personnel. First and foremost is adequate expertise on the steering committee to deal with issues of redundancy and retrenchment. Appropriate identification of the impacts, skills assessments, and training programs need to be devised. Workers should be given a chance to participate in decisions regarding timing, compensation packages, re-training opportunities, etc.

Implementation. The key to implementation is consultation. Ideally a Steering Committee will be formed that is comprised of major Government figures from the road, finance, and civil service sectors, and from local Government ministries. It is also important to have a strong representation from the private sector in such areas as Chambers of Commerce, road associations, The National Construction Council (NCC), institutions of engineers, academia, transport operators, agriculture, tourism, contractors, and consultants. Implementation of the reform will be the responsibility of the department undergoing the transformation. The key unit will be the implementation team, which must have a team leader with good access to top decision-makers when necessary. The team will need a budget to organize meetings, seminars, conferences, and consultancies. Sums of money will need to be set aside to cover transfer and redundancy costs—this should involve the personnel departments of the organizations concerned.

Establishment of Monitoring and Control. The purpose of monitoring is to exert control, learn lessons, and improve the system over time. There is a need for two types of monitoring. The first will monitor key milestones in the transformation process—treating it as a project, using critical path methods and other standard project management techniques. The second type will monitor the results or impact of the transformation once it is complete over a longer period—using logical framework methods. Ideally, impact monitoring should be part of an overall monitoring system of the sector as a whole—and much of the information may already be available from a road maintenance management system. The purpose of the transformation is to improve efficiency of delivery of maintenance services, and it will not necessarily improve the effectiveness of maintenance—for example, whether the right roads are being maintained to appropriate standards. Key relevant indicators may include: (i) road assets; (ii) unit maintenance costs for selected key activities; (iii) overall value, and numbers of contracts performed grouped by contractor class and contract value; (iv) timeliness of contract procurements and payments; (v) volume of force account works being carried out in terms of expenditure and coverage of the network; and (vi) the number of bidders per contract.

Annex 2. Performance-based Contracts

This annex covers performance-based contracts (PBC) that differ significantly from method-based contracts that have traditionally been used to maintain roads in developing countries.[49] Under traditional method-based contracts, the road agency as a client normally specifies techniques, technologies, materials and quantities of materials to be used, together with the time period during which the maintenance works should be executed. The payment to the contractor is based on the amount of inputs (e.g., cubic meters of asphalt concrete, number of working hours). Under a PBC, the client does not specify any method or material requirements. Instead, the client specifies performance indicators that the contractor is required to meet when delivering maintenance services (e.g., maximum roughness, number of potholes). Thus, payments are explicitly linked to the contractor successfully meeting or exceeding these clearly defined performance indicators.

A "simple" PBC would cover a single service (e.g., only mowing, only street light maintenance) and could be awarded for relatively short periods (several months or one year). A "comprehensive" PBC would typically cover all road assets with the right-of-way, and would comprise the full range of services needed to manage and maintain the contracted road network. Such services would include routine maintenance, periodic maintenance, and traffic accident assistance. The contract tenure is usually from 3-10 years, and could go up to 30 years. Rehabilitation is not a compulsory component of a "comprehensive" PBC. Some road agencies include rehabilitation as part of the PBC; others choose to handle rehabilitation using traditional method-based approaches.

The PBC approach offers several advantages. These include: (i) cost savings in managing and maintaining road assets; (ii) greater expenditure certainty for road agencies; (iii) ability to manage the road network with fewer agency staff; (iv) better customer satisfaction; and (v) stable multi-year financing of maintenance. The PBC can lead to cost savings through:

- Incentives to the private sector for innovation and higher productivity;
- Reduction in administrative expenses and road agency overheads, due to better packaging of contracts, requiring fewer agency personnel to administer and supervise contracts; and
- Significantly greater flexibility in the private sector (vs. the public sector) to reward performance and react quickly against non-performers.

A PBC helps to ensure that variation orders are minimized and that the contractor is paid in equal monthly installments throughout the contract period. The risk for cost overruns is transferred to the contractor. The road agency faces fewer unpredictable costs; fewer contracts need to be

[49] This annex extracted from World Bank Technical Note27 "Performance-based Contracting for Preservation and Improvement of Road Assets" by Natalya Stankevich, Navaid Qureshi and Cesar Queiroz. August 2009. http://go.worldbank.org/1JAIRA9Z10

processed and administered; there is no need to measure vast quantities of inputs as a basis for payments. Due to the reduced administrative effort required, the road agency can manage its network with fewer in-house personnel. A PBC approach can help to ensure stable financing for the maintenance program over a longer term as compared with traditional method-based contracts. A PBC typically covers a period of several years—it obliges the Government to make a multi-year funding commitment for road maintenance.

The selection process in performance-based contracting is normally based on the best value—which may not necessarily be the lowest bid. More risks and management responsibilities are carried by the contractor. Therefore, the contracting agency wants to ensure that the potential contractor has: (i) strong management capacity; (ii) a clear understanding of the new approach; and (iii) the ability to handle the associated risks. Under a PBC, payments are made on a fixed-price lump sum basis—normally through uniform installments. Payment is linked to meeting performance targets—the contractor is not paid for physical works completed, but for the final results delivered. The duration of PBCs is typically longer than that of traditional contracts, because the contractor carries greater risk and responsibility, and is obliged to undertake certain maintenance interventions that occur every few years.

Use of PBCs requires the existence of a mature and well-developed contracting industry with the capability to undertake long-term management of contracted assets, assume additional risks, and establish necessary programming and quality assurance mechanisms. To be successful, PBCs need a strong partnering philosophy. This is particularly critical in the initial stages when the client and the contractor have the least experience with this approach, and when performance indicators and monitoring procedures are still evolving. Good communication is essential between the client, the contractors and the supervisor/engineer, in order to facilitate the discussion and prompt resolution of issues and concerns, and to minimize the risk of future disputes and claims.

Performance indicators should be established for each asset to be contracted out. The selection and definition of indicators should be based on: (i) road-user needs, (ii) the expectation of the client to have the completed work reach or surpass the level initially agreed upon; (iii) affordability—or the level of funding available. Only a vital limited number of performance indicators should be specified. Payment conditions should be linked to performance indicators spelled out in the contract. The contractor will be paid a fixed-price lump sum price in the case of compliance with these indicators. Periodically, penalties for non-compliance should be set for each indicator and deducted from scheduled payments. A PBC involves a significant shift in risk and management responsibilities to the contractor. Therefore, the Conditions of Contract should clearly define the new roles of the client and contractor, and should identify all potential risks and allocate each of these to the party that can best manage them.

Annex 3. Performance-based Maintenance Contracting in Estonia and Argentina

The Case of Estonia

From 1995-2000, the Estonian National Road Administration (ENRA) tested several one-year and two-year performance-based contracts (PBCs). The ENRA was satisfied with the results of these experiments, and moved in 2000 to the use of longer-term PBCs on a regular basis. By 2005, 63% of the national road network—specifically 10,288 km of paved and gravel roads—was covered under five-year PBCs, which were fully funded from the central Government budget.

The PBCs are awarded only for those road corridors where rehabilitation is not warranted (i.e., only for maintenance). These contracts typically cover routine maintenance and winter maintenance (snow removal, snow blowing, ice cleaning). As of February 2005, five private contractors were commissioned to execute 12 PBCs. These contracts may not be renewed. At the end of the fifth year, the contractors that have completed their obligations and are interested in continuing for another 5-year term are required to participate in an open competitive bidding again. The legislative framework actually permits the ENRA to extend contracts for up to an additional two years, but contractors in Estonia are interested in longer terms and prefer going through a competition again.

In 1995, a consulting company was hired to supervise one-year and two-year pilot PBCs. After analyzing this experience, the ENRA and its regional offices concluded that the supervision of PBCs required fewer personnel and fewer resources than the supervision of traditional methods of procurement, and could be done by in-house staff. At present, the supervision of contractors executing PBCs is arranged through periodic informal and regular monthly inspections. Periodic inspections are typically done by a single supervisor from the road agency—other agency staff can be engaged if their assistance is needed to resolve emerging problems.

An official commission—appointed by decree of the head of the respective road region—conducts monthly inspections. The Commission usually consists of three supervisors, one traffic person and two representatives from the ENRA. Contractors are not official members of the Commission, but the decree indicates that it is the Contractor's responsibility to assign the appropriate people to represent their interests during the Commission's inspections. The contractors are not obliged to attend monthly inspections, but they receive invitations from the ENRA (or its regional offices) to participate, and they always do. The ENRA is interested in the physical presence of the contractors, because this helps to identify defects and resolve possible disputes on the site. One of the regions (Kagu) has initiated the rotation of its three Commissions from county to county for its monthly site inspections—the objective is to avoid corruption among the parties concerned and achieve better contractor accountability.

Road-users are also encouraged to participate in the monitoring and evaluation of the contractors' work. Billboards with contact information are established along the contracted road corridors to enable road-users to report any deficiencies. Since the deployment of a PBC approach, the ENRA has noticed a decrease in the number of complaints from road-users regarding road conditions.

In 2003, the number of personnel at the ENRA and regional offices was reduced by 29% to 283 as a result of the road management organization reform. One of the reasons for this successful streamlining was the use of PBCs for the outsourcing of routine maintenance works. This reduced the number of workers needed to execute other kinds of road works, and the number of administration staff needed to administer and supervise the contracts themselves.

The ENRA and its State agencies have established strong working relations with their contractors. The Administration arranges bi-annual workshops to bring together representatives of the contractors and road agencies involved in PBCs. The main objectives are: (i) to share experiences from different counties; (ii) to collaboratively discuss lessons learnt; and (iii) to find innovative solutions for the future implementation of PBCs.

The Case of Argentina

The first step for the introduction of maintenance contracts in Argentina was a nationwide road survey to: (i) estimate traffic; (ii) determine the minimum road standards; (iii) define the rehabilitation and maintenance required; and (iv) identify the size and shape of the road network for contracting out. Roads with traffic in the range of 300-3,000 annual average daily traffic (AADT) were deemed eligible for output-based contracting, while those with traffic in excess of 3,000 AADT were deemed concessionable. On the basis of information gathered from the survey, the Government set uniform national output indicators for PBCs.

The first output-based contracts were introduced in August 1995. They were kilometer per month contracts spanning four years—covering about 3,600 kilometers. All 11 contracts were for roads in good or fair condition—roads that were expected to require only routine maintenance. The contractors were paid in equal monthly installments for specified services, as long as the quality of outputs complied with the technical specifications. Given a satisfactory outcome, these contracts were renewed for a further four years.

On the basis of this positive experience, a PBC was designed that combined rehabilitation and maintenance of paved roads—it was called *contrato de recuperación y mantenimiento* (CREMA). It required the contractor to rehabilitate and then maintain a network of roads for five years for a lump sum. Each contract covered road sections varying in length from 100-300

kilometers. The contract specified the sections that needed rehabilitation and the minimum solution required to ensure a positive net present value (NPV).

The bidding was done through international competitive bidding. After the contract was awarded, the contractor was to prepare a detailed engineering design that proposed any rehabilitation solution above the minimum threshold defined in the contract. This involved making a judgment about how much up-front rehabilitation was required to get the roads to a level at which they could be cost-effectively maintained.

The payment schedule was designed to provide incentives for the contractor to maintain the network for the full length of the contract. Up to 60% was to be paid by the end of the first year, when rehabilitation works were completed—the remaining payments were to be made in 48 equal monthly amounts. In addition, the contract required a performance guarantee of 20%. Throughout the contract period, performance was assessed during monthly on-site inspections by the Government engineer and the contractor to verify compliance with minimum standards. This meant: (i) meeting or exceeding the minimum thickness of overlays; (ii) not exceeding the maximum level of roughness, rut depth, cracking or raveling; and (iii) conducting regular visual inspections to verify the existence of potholes, cracking and rutting, and to assess the condition of shoulders, culverts, rails, guardrails, and vertical and horizontal signs.

The CREMA program in Argentina was designed to be implemented in two phases. The first phase covered about 11,700 km and involved a network comprised of 55% of the non-concessioned national paved network. In 1997, 60 contracts were signed, with an average length of about 180 km. The contracts were mostly awarded to local construction companies, with high private sector participation; each contract attracted between 5-20 proposals. The second phase involved 4,000 km and 20 contracts, and was initiated in August 2000.

By making long-term payment obligations legally binding on the Government, the CREMA contracts have prevented the Treasury from failing to provide funding for road maintenance. The program has substantially improved the condition of the network—it reduced the share of roads in poor condition from 25% in 1997 to less than 5% by the end of 1999. Damage to roads caused by vehicle overloading was addressed by asking contractors to provide and operate devised standards for measuring axle-loads, and to report overloading to the relevant authorities. By holding contractors accountable for the future quality of roads, PBCs have built-in incentives to keep them focused on road conditions during the execution of works.

Sources: World Bank (2001), Gerard Liautaud, *Maintaining Roads: Experience with output-based contracts in Argentina*. Public Policy for the Private Sector, Note Number 231, June 2001; World Bank (2006) Performance-based Contracting for Roads in Estonia, available at http://www-esd.worldbank.org/pbc_resource_guide/Case-Estonia-print.htm.

Annex 4. Success Factors for Road Asset Management Systems

A Road Asset Management System (RAMS) is defined here as any system that is used to store and process road and/or bridge inventory, conditions, traffic and related data, for road planning and programming. The major functions of the road management process can be categorized as: (i) Planning; (i) Programming; (iii) Preparation; and (iv) Operations. A RAMS is concerned with road monitoring, planning and programming. Major activities include:

- Needs Assessment;
- Strategic Planning, including budgeting for development and asset preservation;
- Development—under budget constraints—of multi-year works expenditure programs;
- Collection of Data; all of the above activities need data—major data items include road inventory, conditions, traffic, and economic data.

What makes a RAMS successful? In addition to funding, there are three key factors: (i) Processes; (ii) People; and (iii) Technology. If any of these are weak or fail, then the RAMS will be compromised. Some agencies successfully consider all three factors, but many do not. The focus of too many projects is on the technology element—with insufficient attention given to the institutionalization of the system and the necessary support systems. Thus, the major cause of failure in the implementation is poor institutionalization (processes and people) rather than inadequate use of technology. It is essential to ensure that proper attention is given to institutionalization, at the very highest level.

Processes

The introduction of an RAMS by itself is not a guarantee that it will actually be used, or that it will be successful. The agency must also follow basic asset-management principles—strong involvement of executives and managers prior to and during the implementation of the system is absolutely necessary. If the agency's higher management does not recognize the value of the RAMS, they will not provide the necessary support and funding to maintain the system. Therefore, it is important to incorporate the following:

- Business Plans that utilize 'Asset Value' and other Key Performance Indicators derived from the RAMS. This is an executive and managerial responsibility. It also helps put focus on the RAMS itself, and improves the chances that budget and funds are available to run the system;
- Institutional support that consists of high ranking decision-makers fully committed to the asset-management/asset-preservation 'philosophy';
- Regular briefings given to ministers and other high government officials on the importance of asset-preservation, and on the steps that are being taken to ensure that the

maintenance and rehabilitation of the road infrastructure is dealt with in a satisfactory fashion;

- Specific and realistic key performance indicators and targets to measure and preserve/enhance asset value. It is important to monitor those targets, and to make an assessment at the end of each year as to whether they have been achieved—and, if not, to take appropriate action. By publishing this information in Annual Reports, the agency is made accountable;
- Annual budgets in place for data collection and operation of the RAMS. Even if this initially requires donor-funding support, there should be a phased increase in local budgeting to ensure that the RAMS becomes self-funding within a given timeframe;
- Policies and procedures in place for data collection, and for quality assurance of that data.

People

A RAMS should be driven by a dedicated group within the agency—probably in the planning division or equivalent. This group should actively seek to promote the system within the agency—including to higher level management. This group should be tasked with: (i) raising awareness of the system; (ii) managing data collection—constantly look for ways of improving data collection procedures and data quality assurance; (iii) researching off-the-shelf packages and systems on the market; (iv) creating and maintaining technical and functional requirements for planning and programming systems; and (v) coordinating all efforts related to the RAMS in terms of other applications. The following steps should be taken in order to build an appropriate staff environment:

- There should be an organizational unit established with specific responsibility for the RAMS;
- There should be a budget for the operation of the system, including all staffing, equipment, data collection (contracted or in-house), field travel, quality assurance, etc.;
- There should be clear job descriptions for the various activities—and a career path for those in the unit;
- There should be a continual training and development program (and budget) for staff to deal with staff turnover and any necessary re-training. This should potentially include Master's or other post-graduate degrees that would increase the attractiveness of working in this area.

Technology

The Information Technology (IT) requirements of RAMS are demanding. The RAMS implementation should fit within the overall IT strategy of the agency, and should be properly supported from an IT perspective. Agencies should develop and adhere to a long-term IT budget strategy that includes hardware replacement strategies and the costs of hardware and software maintenance agreements.

Annex 5. Technical Assistance for Highway Projects

This annex presents the technical assistance for highways in Azerbaijan under the World Bank, the Asian Development Bank, and the European Bank for Reconstruction and Development. The major technical assistance activities are summarized in Table 12 below. Completed activities do not mean that the various recommendations from different studies have been fully adopted.

Table 12. Major Technical Assistance Activities in the Azeri Road Sector Funded by IFIs

IFI/Project	Activity	Status
World Bank Highway Project (2001-2008)	Development of corporate plan, technical support, training, and other elements necessary for restructuring and modernization of the road department	Completed
World Bank Second Highway Project (2006-2014)	Preparation of Road Law	Completed
	Preparation of Land Acquisition Law	Completed
	Road Data Collection	Ongoing
	Geometric Design/Technical Classification/Maintenance Standards	Ongoing
	Road Master Plan	Ongoing
	Traffic Safety National Policy and Capacity-Building	Ongoing
	Technical Assistance to Investment Division	Ongoing
World Bank Third Highway Project (2010-2015)	Provision of technical assistance, equipment, training, and institution development for the ARS and the Ministry of Transport in motorway operations and maintenance	Ongoing
Asian Development Bank East-West Highway Improvement Project (2006-2010)	Institutional strengthening activities in the following four areas: (i) road maintenance; (ii) axle load control; (iii) road safety; and (iv) project management and implementation.	Completed
Asian Development Bank Road Network Development Program (2008-2013)	Preparation of Legal and Regulatory Framework and Operational Procedures for Toll Roads	Ongoing
EBRD Grant to assistance in implementation of the Corporate Plan (2008-2010)	Technical assistance for the implementation of key recommendations of the Corporate Plan, which was prepared under the Highway Project financed by the World Bank. The objective is to assist the ARS in institutional strengthening of road maintenance works.	Completed

The first World Bank-financed transport project in Azerbaijan was the Highway Project for the reconstruction and upgrading of the selected portions of the existing East-West Highway from Ganja to Gazakh (94km). The project included an institutional development component in the road sector. Its implementation rested on a major consulting contract with the Finnroad/Dornier team. The technical assistance served to acquaint sector officials with the general principles and topics of modern road sector management. It was reported in ICR that the recommendations of the studies were partially adopted and the ARS needed to continue implementation of the proposed reforms for further modernization of the road sector management.[50]

The World Bank has continued its support to the institutional strengthening of the road sector under the Second Highway Project—which was built on the aforementioned technical assistance program started under the Highway Project. The technical assistance component under the Second Highway Project includes: (i) updating and modernizing the Road Law; (ii) improving and expanding the computer systems in the MOT, the ARS and the ARS's Regional Offices; (iii) completing the Road Data Bank; (iv) establishing technical road classes superimposed on the functional road classification; (v) developing a model for the Service Agreement between the ARS and its Regional Offices, and (vi) developing the capacity of the Ecology and Safety Sector and the Land Acquisition Department in the ARS. Provision of technical assistance to the MOT and the ARS was continued under the First Additional Financing (Second Highway Project), which entailed development of standard documents for domestic investment projects, a traffic safety strategy, a road master plan, seminars and training to the Investment Division of the ARS.

Most of the technical assistance activities under the Second Highway and First Additional Financing are either completed or under implementation. Meanwhile, the technical assistance program under the Bank-financed road projects has been implemented in coordination with institutional strengthening programs of other donors in order to build up on existing capacity and avoid overlapping. For example, the ARS has received the EBRD grant for the implementation of the Corporate Plan, which entails institutional strengthening of the maintenance works of the ARS. The consultancy assistance to selected three pilot maintenance units is aimed at assisting in preparation of service-level agreements that will define contractual relationships between the maintenance management divisions and maintenance works units of the ARS. Similar technical assistance activity was envisaged under the Second Highway Project, and this activity was dropped in order to avoid overlapping. The status of technical assistance activities under the Second Highway Project and First Additional Financing[51] is described in Table 13.

Table 13. World Bank Technical Assistance

Project	Technical Assistance Activity	Status
Highway II	Seminar on Road Financing	Completed
	Review of the Expropriation Law and Proposed Amendment to the Law	Completed
	Financial Management Technical Assistance	Completed

[50] Implementation Completion and Results Report Highway Project, Report No:ICR00001094, the World Bank, September, 2009

[51] There is not a TA component under the Second Additional Financing of the Second Highway Project

	Investment and Maintenance Programming	Completed
	Preparation of Road Law	Completed
	Preparation for Data Collection Strategy	Completed
	Geometric Design/Technical Classification/Maintenance Standards	Under Implementation
	Data Collection Contract	Under Implementation
	Preparation of Expropriation Law of Azerbaijan	Completed
	Improving and Expanding the Computer Systems in the MOT, the ARS and the ARS's Regional Offices	Under Implementation
	Developing the Capacity of the Ecology and Safety Sector and the Land Acquisition Department in the ARS.	Workshops and trainings were conducted. Further capacity-building activities will be conducted under PICBP
First Additional Financing Highway II	Revision of the Civil Engineering Curriculum	Expected to be continued under Public Investment Capacity Building Project
	Development of Standard Documents for Domestic Investment Projects	Not Started
	Transport Master Plan	Not Started
	Traffic Safety National Policy and Capacity-Building	Under Implementation
	Technical Assistance to the Investment Division	Under Implementation

The Asian Development Bank has provided loans to finance the East-West Highway Improvement Project, which involves (i) the reconstruction of the Yevlakh-Ganja section via the Ganja bypass (89 km) and the Qazakh-Georgian border section (38 km); and (ii) improvements of local roads in the project area (about 65 km). The project includes a technical assistance component on institutional strengthening for the road sector in four areas: (i) road maintenance; (ii) axle load control; (iii) road safety; and (iv) project management and implementation. The ARS selected the consulting firm Finnroad according to the ADB's guidelines for the implementation of this component of the project. Implementation of all four activities will be completed in January 2010.

The ARS also received a grant from the EBRD for the implementation of key recommendations of the Corporate Plan—which was prepared under the Highway Project financed from a World Bank Credit. The objective of this technical assistance is to help the ARS in strengthening the institutional framework governing road maintenance works. The intention is that the relationship between each regional maintenance management division and each maintenance works unit should be governed by a 'service-level' agreement in a form similar to a contract. The consultancy supported the selection of three pilot maintenance units. The aim was to assist these

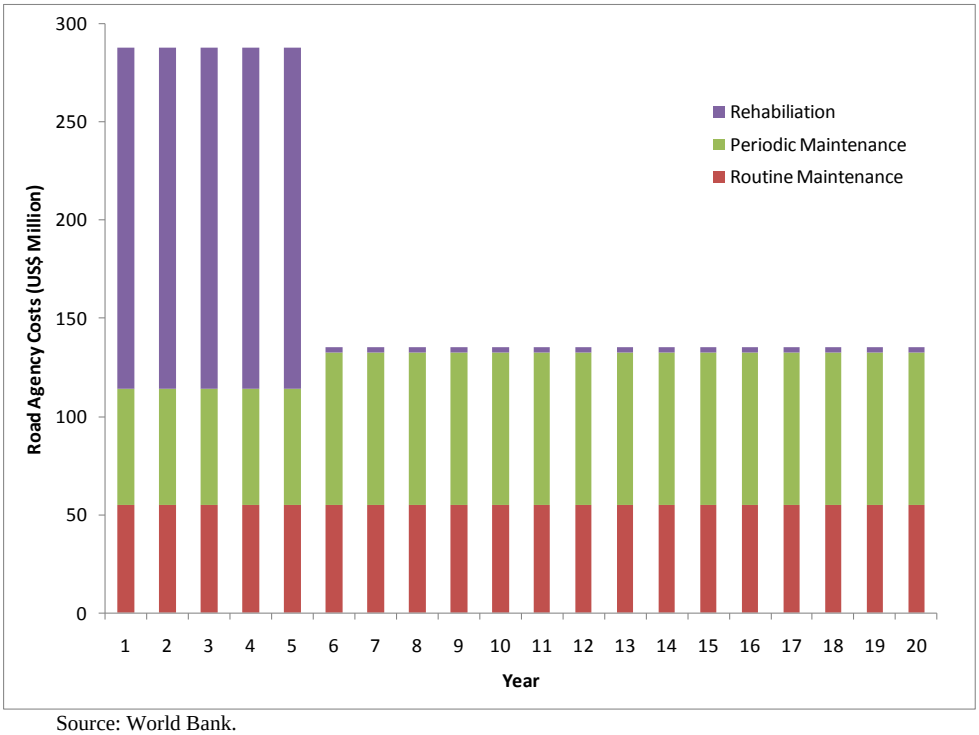
organizations in operating as ‘contractors’—undertaking activities identified and specified to the quality standards and other requirements set out in the relevant service-level agreement. Implementation was completed in May 2010.

Annex 6. HDM-4 Scenarios for Addressing the ARS Roads Rehabilitation Backlog

Option 1: Minimize Total Transport Costs Scenario

This scenario selects the maintenance standard per road class that minimizes the present value sum of road agency costs plus road-user costs (total transport costs) over the evaluation period. It is thus the optimal scenario from an economic point of view. The total rehabilitation backlog is estimated to be US$1.44 billion. Thus, the estimates under scenario 1 suggest that in order to improve the overall condition of the road network, the AzerRoadService (ARS) would need to invest a total of US$288 million per year for the next five years—the recommended breakdown would be US$174 million for rehabilitation, US$59 million for periodic maintenance, and US$55 million for routine maintenance. Assuming that the country meets its maintenance and rehabilitation requirements for the first five years—and clears most of the rehabilitation backlog—the total expenditures from years 6-20 would fall to US$136 million per year—and the recommended breakdown would be US$3 million for rehabilitation, US$78 million for periodic maintenance, and US$55 million for routine maintenance works. The present value—at 12% discount rate—of this expenditure profile corresponds to US$ 1,808 million. This scenario achieves a target of attaining 83% of main roads in good or fair condition by 2020. Figure 8 presents this scenario.

Figure 8. Option 1: Minimize Total Transport Costs: Annual Road Expenditures from Years 1-20 (US$ millions)

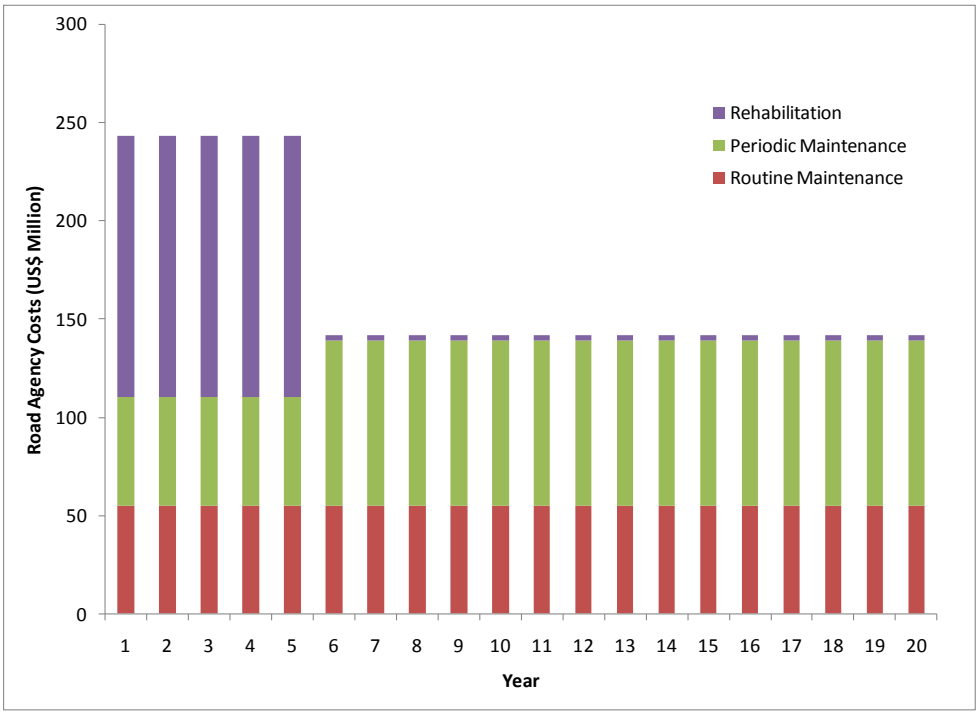


Source: World Bank.

Option 2: Expenditures of US$243 Million per Year Scenario

This scenario utilizes the expenditures by the ARS for 2009 for road maintenance and rehabilitation works. If the ARS were to invest a total of US$243 million per year for the next five years, the recommend breakdown would be US$133 million for rehabilitation, US$55 million for periodic maintenance, and US$55 million for routine maintenance. The total expenditures from years 6-20 would fall to US$142 million per year—and the recommended breakdown would be US$3 million for rehabilitation, US$84 million for periodic maintenance, and US$55 million for routine maintenance works. The present value—at 12% discount rate—of this expenditure profile corresponds to US$1,627 million. This scenario achieves a target of attaining 77% of roads in good or fair condition by 2020. Figure 9 presents this scenario.

Figure 9. Option 2: Expenditures of US$243 million per Year: Annual Road Expenditures from Years 1-20 (US$ millions)



Source: World Bank estimates.

Option 3: Keep Current Road Condition Scenario

This scenario takes into consideration the current condition of the network and assumes that this condition will be maintained in the future. The estimates suggest that in order to maintain the current road condition, the ARS would need to invest a total US$162 million per year for the next five years—the recommended breakdown would be US$58 million for rehabilitation, US$49 million for periodic maintenance, and US$55 million for routine maintenance. The total expenditures from years 6-20 would fall to US$121 million per year—and the recommended breakdown would be US$22 million for rehabilitation, US$44 million for periodic maintenance,

and US$55 million for routine maintenance works. The present value—at 12% discount rate—of this expenditure profile corresponds to US$1,272 million. Under this scenario, 39% of roads would be in good or fair condition in 2020.

Annex 7. HDM-4 Road Maintenance Works Economic Evaluation

The HDM-4 Model

The Highway Development and Management (HDM-4) Model was employed to evaluate the economic benefits of road maintenance and rehabilitation works on the South Caucasus. The model estimates over a given evaluation period, for a series of user-defined road agency standards, the pavement deterioration that is a function of: (i) the road geometry, age and condition, (ii) the daily traffic and projected traffic growth rate, (iii) the climate, and (iv) the loading of trucks. The pavement condition is measured in terms of: (i) pavement strength (e.g., deflections); (ii) pavement surface distress (e.g., area of cracking and potholes); and (iii) pavement deformations (e.g., rutting and roughness). For an economic evaluation, the pavement condition is best represented by the longitudinal deformation of a road—which affects vehicle speeds, users' comfort and road-user costs. For each year of the evaluation period, the model estimates the road agency costs (rehabilitation, periodic maintenance and recurrent maintenance costs), and the road-user costs (vehicle operating and passenger time costs). The sum of the road agency and road-user costs represent the total transport costs. The objective of the evaluation is to compare the total agency costs and total transport costs of the series of road agency standards in present value terms, because this is needed to assess the timing of costs and the opportunity cost of capital in the country—which is represented by the discount rate. Without generated traffic, the recommended road agency standard is the one that minimizes the present value of total transport costs.

Primary Road Works Economic Evaluation

The evaluation considered a 20-year evaluation period—with a 12% discount rate and a 4% annual traffic growth rate. Four asphalt concrete roads were evaluated. Each carried approximately 3,000 vehicles per day (AADT). Each had different road conditions: one good; one fair; one poor; and one very poor. For all roads, the Do Minimum standard corresponds to not performing any annual recurrent maintenance works (e.g., patching, crack sealing, drainage maintenance, shoulder repair) over the evaluation period, and to reconstructing the road when it reaches a extremely poor condition—with roughness equal to 16.0 IRI, m/km. The other standards evaluated per road class are as follows:

- For the road in good condition, five periodic maintenance standards were evaluated comprised of applying a 50 mm overlay triggered at 3.5, 4.0, 4.5, 5.0 or 5.5 IRI, m/km—all including annual recurrent maintenance works over the evaluation period.
- For the road in fair condition, three periodic maintenance standards were evaluated comprised of applying a 50 mm overlay triggered at 4.5, 5.0 or 5.5 IRI, m/km—all including annual recurrent maintenance works over the evaluation period. Another standard comprised reconstructing the road when it reaches 8.0 IRI, m/km—including

annual recurrent maintenance works over the evaluation period. The last standard represented performing only recurrent maintenance over the evaluation period.

- For the road in poor condition, four reconstruction standards were evaluated that were triggered at 8.0, 10.0, 12.0 and 16.0 IRI, m/km—all including annual recurrent maintenance works.
- For the road in very poor condition, two reconstruction standards were evaluated that were triggered at 12.0 and 16.0 IRI, m/km—all including annual recurrent maintenance works.

The following table presents the representative unit costs of road works adopted on the evaluation, based on South Caucasus average costs. Economic costs are 80% of financial costs.

Road Works Unit Costs				
Road Work Class	Roar Work Type	Units	Financial	Economic
Recurrent Maintenance	Routine Maintenance Primary	US$/km-year	3,000	2,400
	Routine Maintenance Local	US$/km-year	1,000	800
	Patching	US$/m2	17.9	14.3
	Crack Sealing	US$/m2	6.0	4.8
Periodic Maintenance	50 mm Overlay	US$/m2	17.9	14.3
Rehabilitation	Reconstruction AC Road	US$/m2	55.0	44.0
	Reconstruction ST Road	U$/m2	40.0	32.0

The following table presents the representative economic unit road-user costs (vehicle operating costs plus passenger time costs) for different roughness levels, based on South Caucasus average vehicle fleet characteristics, and the average traffic composition. A road in fair condition (6 IRI, m/km) has road-user costs 7% higher than a road in good condition (2 IRI, m/km), whereas a road in poor condition (10 IRI, m/km), has road-user costs 24% higher, and a road in very poor condition (14 IRI, m/km) has road-user costs 49% higher.

Unit Road-user Costs Sensitivity to Roughness (US$/vehicle-km)									
Condition	Roughness (IRI,	Medium Car	Delivery Vehicle	Light Truck	Medium Truck	Heavy Truck	Articulated Truck	Small Bus	Medium Bus
Good	2	0.28	0.28	0.29	0.43	0.67	0.98	0.53	1.21
Fair	4	0.28	0.29	0.30	0.45	0.71	1.03	0.54	1.25
Fair	6	0.29	0.30	0.33	0.48	0.76	1.06	0.58	1.35
Poor	8	0.30	0.32	0.35	0.51	0.79	1.09	0.65	1.53
Poor	10	0.33	0.35	0.37	0.55	0.84	1.17	0.74	1.77
Very	12	0.36	0.39	0.41	0.59	0.91	1.27	0.84	2.04
Very	14	0.39	0.42	0.44	0.64	0.99	1.37	0.95	2.32
Very	16	0.43	0.46	0.48	0.69	1.07	1.48	1.06	2.61
Traffic Composition		60	20	3	5	5	2	2	3

The following table presents the economic evaluation results in terms of present value of road agency costs, road-user costs, total transport costs, the reduction of total transport costs compared with the Do Minimum standard (Net Benefits or NPVs), in US$ 000 per km, and the NPV per present value of road agency costs ratio. The standard that minimizes total transport costs is considered the optimal alternative from an economic evaluation point of view. With traffic of 3,000 vehicles per day, the present value of road-user costs represents on average 98% of total transport costs. The NPV per Agency Costs ratio for roads in good and fair condition (3.0 and 2.8 respectively) is higher than for the roads in poor or very poor condition (1.3 and 1.9 respectively). This indicates that road works for roads in good and fair condition should have higher priority than road works for roads in poor or very poor condition.

Primary Road Present Values (US$ 000 per Kilometer) and NPV/Agency Ratio						
Road Class	Maintenance Standard	Agency	Road	Total	NPV	NPV/Agency
Good Condition	Reconstruction at 16.0 IRI, m/km	88.5	4796.4	4884.9	0.0	0.0
	RM + 50 mm Overlay at 3.5 IRI,	105.5	4592.4	4697.9	187.0	1.8
	RM + 50 mm Overlay at 4.0 IRI,	69.1	4610.8	4679.9	205.1	3.0
	RM + 50 mm Overlay at 4.5 IRI,	60.7	4623.5	4684.3	200.7	3.3
	RM + 50 mm Overlay at 5.0 IRI,	51.5	4645.6	4697.1	187.8	3.6
	RM + 50 mm Overlay at 5.5 IRI,	46.9	4661.6	4708.5	176.5	3.8
	RM	27.7	4700.3	4728.0	156.9	5.7
Fair Condition	Reconstruction at 16.0 IRI, m/km	124.4	4908.7	5033.1	0.0	0.0
	RM + 50 mm Overlay at 4.5 IRI,	135.0	4614.2	4749.2	283.9	2.1
	RM + 50 mm Overlay at 5.0 IRI,	102.8	4641.9	4744.8	288.3	2.8
	RM + 50 mm Overlay at 5.5 IRI,	88.5	4669.5	4758.0	275.1	3.1
	RM + Reconstruction at 8.0 IRI,	92.0	4826.4	4918.4	114.7	1.2
	RM	30.2	4927.0	4957.2	75.8	2.5
Poor Condition	Reconstruction at 16.0 IRI, m/km	139.3	5253.5	5392.8	0.0	0.0
	RM + Reconstruction at 8.0 IRI,	330.0	4643.9	4973.9	418.9	1.3
	RM + Reconstruction at 10.0 IRI,	201.0	4922.7	5123.7	269.1	1.3
	RM + Reconstruction at 12.0 IRI,	127.9	5248.1	5376.0	16.8	0.1
	RM + Reconstruction at 16.0 IRI,	71.2	5787.3	5858.5	-	-6.5
Very Poor Condition	Reconstruction at 16.0 IRI, m/km	174.8	5530.2	5705.0	0.0	0.0
	RM + Reconstruction at 12.0 IRI,	330.0	4739.7	5069.7	635.3	1.9
	RM + Reconstruction at 16.0 IRI,	139.3	6015.2	6154.5	-	-3.2

NPV = Net benefits compared with Do Minimum standard

RM = Recurrent maintenance

For roads in good condition, the standard of executing recurrent maintenance and 50 mm overlays when the roughness reaches 4.0 IRI, m/km yields the lowest total transport costs; thus, 4.0 IRI, m/km, is the optimal maximum roughness threshold for periodic maintenance for this

level of traffic and road condition. To execute only recurrent maintenance has positive NPVs of, US$157 thousand per km, but the NPVs are 23% lower than the standard that executes the 50 mm overlay at 4.0 IRI, m/km (US$205 thousand per km). Thus, a policy of executing periodic and recurrent maintenance works is preferred to a policy of executing only recurrent maintenance works or a policy of reconstructing the road when it reaches poor condition.

For the road in fair condition, the standard of executing recurrent maintenance and 50 mm overlays when the roughness reaches 5.0 IRI, m/km yields the lowest total transport costs; thus, 5.0 IRI, m/km, is the optimal maximum roughness threshold for periodic maintenance for this level of traffic and road condition. To execute only recurrent maintenance over the evaluation period has positive net benefits, but they are 74% lower than the standard that executes the 50 mm overlay at 5.0 IRI, m/km. Thus, a policy of executing periodic and recurrent maintenance works is preferred to a policy of executing only recurrent maintenance works or a policy of reconstructing the road when it reaches poor condition.

For the road in poor condition, the standard of executing recurrent maintenance and reconstruction when the roughness reaches 8.0 IRI, m/km yields the lowest total transport costs; thus, 8.0 IRI, m/km, is the optimal roughness threshold for reconstruction for this level of traffic and road condition. To standard that executes recurrent maintenance over the evaluation period and reconstructs at 16 IRI, m/km, has negative net benefits—with the present value of total transport costs higher than performing the Do Minimum standard. Thus, a policy of executing immediate reconstruction followed by recurrent maintenance works is preferred to a policy of postponing the reconstruction.

For the road in very poor condition, the standard of reconstructing the road and executing recurrent maintenance afterwards yields the lowest total transport costs. To execute only recurrent maintenance over the evaluation period and reconstruct at 16 IRI, m/km, has negative net benefits. Thus, a policy of executing immediate reconstruction, followed by recurrent maintenance works, is preferred to a policy of postponing the reconstruction.

Local Road Works Economic Evaluation

Adopting the same assumptions for the primary road, four surface treatment roads were evaluated that each carries approximately 500 vehicles per day (AADT). Each had different road conditions: one good; one fair; one poor; and one very poor. For all roads, the Do Minimum standard corresponds to not performing any annual recurrent maintenance works over the evaluation period, and to reconstructing the road when it reaches an extremely poor condition—with roughness equal to 16.0 IRI, m/km. The other standards evaluated per road class are as follows:

- For the road in good condition, five periodic maintenance standards were evaluated comprised of applying a 50 mm overlay triggered at 4.5, 5.0, 5.5, 6.0 or 6.5 IRI, m/km—

all including annual recurrent maintenance works over the evaluation period. The last standard represents performing only recurrent maintenance over the evaluation period.

- For the road in fair condition, three periodic maintenance standards were evaluated comprised of applying a 50 mm overlay triggered at 5.5, 6.0 or 6.5 IRI, m/km—all including annual recurrent maintenance works over the evaluation period. Another standard comprised reconstructing the road when it reaches 8.0 IRI, m/km—including annual recurrent maintenance works over the evaluation period. The last standard represents performing only recurrent maintenance over the evaluation period.
- For the road in poor condition, four reconstruction standards were evaluated that were triggered at 8.0, 10.0, 12.0 and 16.0 IRI, m/km—all including annual recurrent maintenance works.
- For the road in very poor condition, two reconstruction standards were evaluated that were triggered at 12.0 and 16.0 IRI, m/km—all including annual recurrent maintenance works.

The following table presents the economic evaluation results. With traffic of 500 vehicles per day, the present value of road-user costs over the evaluation period represents on average 90% of total transport costs. The NPV per Agency Costs ratio for roads in good and fair condition (1.3 and 1.0 respectively) is higher than for the roads in poor or very poor condition (0.5 and 0.5 respectively). This indicates that periodic maintenance road works on roads in good and fair condition should have higher priority than rehabilitation works on roads in poor and very poor condition. For roads in good and fair condition, performing periodic maintenance at 5.5 IRI, m/km, and recurrent maintenance, is preferred to performing only recurrent maintenance or performing recurrent maintenance and reconstruction. For roads in poor and very poor condition, performing reconstruction at 10 and 12 IRI, m/km, respectively, is preferred to postponing the reconstruction to be triggered at 16 IRI, m/km.

Local Roads Present Values (US$ 000 per Kilometer) and NPV/Agency Ratio						
Road Class	Maintenance Standard	Agency	Road	Total	NPV	NPV/Agency
Good Condition	Reconstruction at 16.0 IRI, m/km	28.0	977.3	1005.3	0.0	0.0
	RM + 50 mm Overlay at 4.5 IRI,	46.1	918.6	964.7	40.6	0.9
	RM + 50 mm Overlay at 5.0 IRI,	38.9	922.4	961.3	43.9	1.1
	RM + 50 mm Overlay at 5.5 IRI,	33.2	928.0	961.1	44.1	1.3
	RM + 50 mm Overlay at 6.0 IRI,	30.9	931.2	962.1	43.2	1.4
	RM + 50 mm Overlay at 6.5 IRI,	28.8	934.5	963.4	41.9	1.5
	RM	10.5	954.0	964.6	40.7	3.9
Fair Condition	Reconstruction at 16.0 IRI, m/km	49.3	1023.9	1073.2	0.0	0.0
	RM + 50 mm Overlay at 5.5 IRI,	70.5	932.0	1002.5	70.7	1.0
	RM + 50 mm Overlay at 6.0 IRI,	64.5	938.2	1002.7	70.4	1.1
	RM + 50 mm Overlay at 6.5 IRI,	54.4	950.7	1005.1	68.1	1.3
	RM + Reconstruction at 8.0 IRI,	67.8	969.5	1037.3	35.9	0.5
	RM	14.6	1027.4	1042.1	31.1	2.1
Poor Condition	Reconstruction at 16.0 IRI, m/km	69.2	1113.7	1182.9	0.0	0.0
	RM + Reconstruction at 8.0 IRI,	200.0	925.1	1125.2	57.7	0.3
	RM + Reconstruction at 10.0 IRI,	133.2	988.5	1121.7	61.2	0.5
	RM + Reconstruction at 12.0 IRI,	90.5	1061.4	1152.0	31.0	0.3
	RM + Reconstruction at 16.0 IRI,	47.5	1213.8	1261.3	-78.4	-1.6
Very Poor Condition	Reconstruction at 16.0 IRI, m/km	108.9	1139.7	1248.7	0.0	0.0
	RM + Reconstruction at 12.0 IRI,	199.7	947.6	1147.3	101.3	0.5
	RM + Reconstruction at 16.0 IRI,	83.3	1270.1	1353.4	-	-1.3

NPV = Net benefits compared with Do Minimum standard

RM = Recurrent maintenance

Optimal Periodic Maintenance Treatment

The following table presents a sample evaluation of the consequences of over-design and under-design of a periodic maintenance treatment represented by maintenance standards that are not appropriate for the traffic of the given road. The evaluation considers a sample road that is in fair condition (4.0 IRI, m/km) and has 3,000 vehicles per day. Four periodic maintenance standards are evaluated: (i) perform recurrent maintenance and rehabilitate the road when it is in very poor condition (16 IRI, m/km)—which is the Do Minimum scenario; (ii) perform recurrent maintenance and apply as periodic maintenance a 12 mm reseal every time the area of cracking reaches 20%; (iii) perform recurrent maintenance and apply as periodic maintenance a 50 mm overlay when the roughness reaches 5.0 IRI, m/km; and (iv) perform recurrent maintenance and apply an 80 mm overlay as periodic maintenance when the roughness reaches 5.0 IRI, m/km.

Present Values (US$ 000 per Kilometer)				
Road Agency Standard	Road Agency Cost	Road User Cost	Total Transport Costs	Net Benefits, (NPV) *
Reconstruction at 16.0 IRI, m/km (Do	124.4	4908.7	5033.1	0.0
RM + Reseal 12mm at 20% Cracking Area	55.6	4851.3	4906.9	126.2
RM + 50 mm Overlay at 5.0 IRI, m/km	102.8	4641.9	4744.8	288.3
RM + 80 mm Overlay at 5.0 IRI, m/km	151.3	4628.0	4779.3	253.8

* Comparison with Do Minimum scenario

The evaluation shows that the periodic maintenance standard that minimizes total transport costs is the one that applies a 50 mm overlay at 5 IRI, m/km. Applying an 80 mm overlay (over-design) or a 12 mm reseal (under-design) as periodic maintenance yields higher total transport costs over the evaluation period. Applying a 12 mm reseal reduces net benefits by 56%, and applying an 80 mm overlay reduces net benefits by 12%, compared with the optimal standard of applying a 50 mm overlay. Thus, the optimal maintenance standard for a given road (i.e., given traffic and condition) should be defined based on a life-cycle economic evaluation to minimize total transport costs or maximize society net benefits.