Road Sector Investment Planning in the Pacific

AN EXAMPLE OF GOOD PRACTICE

Timor-Leste

Asian Development Bank
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ADB study on road sector planning and investment in Timor-Leste


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Foreword

The Asian Development Bank (ADB) has been extensively involved in assisting countries in the Asia and Pacific region to use road investment programs, through technical assistance, loans, and grants, as a spearhead for sustainable development and poverty reduction. This publication, as part of the Pacific Studies Series, provides development practitioners and the governments of ADB’s Pacific developing member countries (DMCs) with analyses promoting poverty alleviation and sustainable development. The studies also shed light on the complex problems facing governments and people in the Pacific islands. The substance of the studies gives recommendations for development strategies that are built on the social, cultural, political, and technical characteristics of each nation.

Infrastructure has always played a central role in the Asian development model: to promote economic growth, to share the benefits of growth with poor and vulnerable groups and communities, and to connect countries within the region and with the rest of the world. There is no doubt that infrastructure development contributes to sustainable development and poverty reduction in the Pacific DMCs. At the same time, questions and concerns have been raised about the impact of infrastructure development on the environment and local communities, about waste through corruption in public spending and private contracts, about the appropriate roles of the public and private sectors in infrastructure financing, ownership and management of infrastructure assets, and the distribution of benefits between stakeholders. This publication treats many of these problems in the context of a case study from Timor-Leste.

This study presents the methods used and lessons learned from the Timor-Leste road-sector planning project, completed in 2005, which was done in a post-conflict nation seeking to recover from severe poverty, political instability, and violent conflict. These lessons learned are woven into an overall approach to road sector Master Planning in Pacific DMCs, and how to process a loan or grant to support such a plan. It is our hope that this publication will provide
practitioners and DMC government professionals with valuable tools and insights into developing and implementing short-, medium-, and long-term road network plans, maintenance plans, and institutional strengthening so that the road sector can become an engine for growth, sustainable development, and poverty reduction.

Philip Erquiaga
Director General
Pacific Department
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### Abbreviations

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<tr>
<td>AADT</td>
<td>annual average daily traffic</td>
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<td>ADB</td>
<td>Asian Development Bank</td>
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<td>CFET</td>
<td>Consolidated Fund for East Timor</td>
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<td>CIF</td>
<td>cost insurance and freight</td>
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<td>DLT</td>
<td>Directorate of Land Transport</td>
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<td>DMC</td>
<td>developing member country of ADB</td>
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<td>EA</td>
<td>executing agency</td>
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<td>EIRR</td>
<td>economic internal rate of return</td>
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<td>GDP</td>
<td>growth domestic product</td>
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<tr>
<td>GPS</td>
<td>global positioning system</td>
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<td>HDM-4</td>
<td>Highway Development and Management Model</td>
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<td>MDG</td>
<td>Millennium Development Goal</td>
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<tr>
<td>NPV</td>
<td>net present value</td>
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<td>PWD</td>
<td>Public Works Department</td>
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<td>RAMS</td>
<td>road asset maintenance system</td>
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<td>TA</td>
<td>technical assistance</td>
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<tr>
<td>VAT</td>
<td>value-added tax</td>
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<td>VO</td>
<td>variation order</td>
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<tr>
<td>VOC</td>
<td>vehicle operating costs</td>
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Note: In this report, “$” refers to US dollars.
Introduction

The Asian Development Bank’s (ADB) overarching goal is poverty reduction throughout Asia and the Pacific. Research has shown that improving the transport sector in developing countries is necessary—but not sufficient—condition for development and poverty reduction. Because ADB aims to increase knowledge sharing throughout its developing member countries (DMCs), ‘knowledge products’ are being developed for different technical and thematic areas. The objective of the ‘knowledge products’ is to provide decision makers, professionals, and executing agencies in DMCs with the tools, knowledge, and capacity to increase their expertise in these areas.¹

This knowledge product examines the lessons learned from the Timor-Leste road-sector planning project in the areas of road sector planning in the context of poverty reduction and sustainable development. These lessons learned are woven into an overall approach to road sector Master Planning in DMCs, and a set of steps are given to prepare the necessary documentation to process a loan or grant for a portion of such a plan for approval by the ADB’s Board of Directors.

The road sector is a critical link in the development process and should be a spearhead for development and not a constraint, as is the current condition of the roads and the institutional structure supporting road development, maintenance, and transport services in the lesser-developed DMCs, and especially those in the Pacific Region. The transport-planning methods presented here seek to optimize the limited resources available for road-sector maintenance and related institutional strengthening.

ADB’s experience in Timor-Leste provides practitioners with pragmatic analytical tools and methods to develop necessary short-, medium-, and long-term road network plans, maintenance plans, and institutional strengthening. These tools, when properly applied, will enable ADB to assist the lesser-developed and Pacific Region DMCs manage a road sector that is better able to promote development and reduce poverty.

As in many of these DMCs, Timor-Leste has been faced with recent and continued internal strife. The intensity and duration of the strife is often due to frustration at the Government’s failure to achieve significant development gains, and the ability of the Government to share decision-making with other private stakeholders.2

The proposed ADB grant to Timor-Leste was prepared based on a feasibility study conducted in 2005 and funded by an ADB Technical Assistance (TA).3 The goal of the feasibility study was to prepare in detail a 1-year road investment program for an immediate ADB grant to Timor-Leste, but in the context of a comprehensive 5- and 10-year road sector development plan that covered all primary and secondary roads in the country. The proposed first-year project, with construction to start in 2007, included four main components:

- Rehabilitation of three road links,
- Labor-Intensive Maintenance of an additional road link,
- Community Empowerment Initiative, and
- Institutional strengthening of the Public Works Department (PWD).

The fourth component lays the foundation for the three other components. Institutional strengthening should provide local officials and practitioners with the tools and the capacity to implement planning methods and sustain long-term maintenance and rehabilitation programs.

Since countries vary in culture, history, education levels, size, natural resource endowments, infrastructure capacity, and institutional structures, the methods presented here must be customized to each country or region in

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2 The frustration with the government is supported by some evidence collected during the analysts’ survey work for the road project presented in the social and poverty analyses. See the Final Report for ADB TA-3731-TIM for more on this topic.

which they are applied. Project designs must be developed with the country’s context in mind. Sociocultural norms, geography, climate, government structures, levels of education, endowments of natural resources, gender roles, and poverty levels are all factors that affect the development of a transport project design and should be considered at the onset of the process.
Overall Methodology

A. Pre-Feasibility Study Actions

The first step leading to a feasibility study of this nature is to discuss and agree with the host-country government the scope, terms and conditions of the program, and the purpose of ADB’s loan or grant. The usefulness of combining a straightforward rehabilitation of a major trunk road or other well-defined discrete road project with an overall long-term planning process, use of appropriate technologies, and institutional strengthening is that the initial grant or loan will set the stage for sustainable road-sector development and management. Moreover, the identification of the discrete road program to be covered by the grant or loan should not be determined in these negotiations; rather, the results from the feasibility study based on an overall program will identify the road segments with the highest priority for improvement. This identification process allows ADB to avoid the delicate problem of having the host-country government alone determine the roads to be improved with the loan or grant, before any objective assessment of the system has been made.

Once the program has been agreed upon, ADB staff will carry out an initial assessment of the project and program. Based on this initial assessment, the ADB project officer will structure a terms of reference and engage consultants to carry out the feasibility study.
B. Initial Work to Be Done Under the Feasibility Study

As the consulting team mobilizes, there are a number of tasks to be done, including

(i) Establishing a relationship with the Executing Agency (EA) of the Government, usually a Ministry of Transport or the Department of Public Works;
(ii) Coordinating with the in-country ADB office, as well as the project officer and staff in Manila;
(iii) Identifying the key stakeholders for the project and the long-term program;
(iv) Coalescing the local consultants and the expatriate consultants into a team;
(v) Rapid visual inspection of the road network of the country; and
(vi) Rapid assessment of the history, politics, topography, natural resource endowment, socioeconomic situation, and the capacity of EA and related government agencies.

These steps should then culminate in a stakeholders' workshop where the consulting team, with ADB staff present, presents and discusses the purpose of the work, including the planned economic analysis, engineering work, social assessment, gender analysis, poverty analysis, environmental analysis, and the theme of institutional strengthening. The purpose of the workshop is to collect early inputs from the stakeholders on the project, to explain how the project will unfold to the stakeholders, including government and EA staff, and to formally introduce the consulting team to the stakeholders. The links to the stakeholders will be crucial to effectively carrying out the work as the feasibility study progresses.

With the overall approach and methods to be used adapted to the country context in draft form, the consulting team will write the inception report. While all parts of the inception report are important, the section dealing with expected problems is crucial. These are very context-specific and highlight the unique issues facing the country, EA, the capacity of the local consultants, and the need for program amendments likely to require Variation Orders (VOs).
Depending on the country, the feasibility study team should ensure that there are high-quality road maps and statistics on traffic flows. Secondary data on topography, geology, environmental conditions, population, natural resources, social conditions, culture, public sector structure and capacity, economic structure, and macroeconomic conditions also are collected at this time. All secondary data listed here are necessary to serve as benchmarks to proceed with the tasks of the feasibility study. Feasibility study team members should establish good professional contacts with other funding agencies and collect information on all other funding agency programs in the country. This should help promote coordination among funding agencies. As the secondary data are collected from various sources, the feasibility study team members establish good professional contacts with many government agencies, civil society organizations, and key private-sector stakeholders. These contacts will be needed as the team carries out the study.

As is often the case for the road sector, high-quality road maps and traffic-count data were not available in Timor-Leste. The feasibility study team then proceeded to measure the chainage (i.e., exact length of all road segments) of the primary and secondary road networks, and conduct traffic counts at critical locations on the road network. In Timor-Leste, the primary and secondary road networks were in such poor condition that the scope of the feasibility study was limited to these two networks. In countries where the primary network is in good condition, the study may focus on the secondary and feeder road networks. All three networks must function well if transport is to spearhead sustainable development. However, if the primary and secondary road networks are in danger of failing, as is the case in Timor-Leste, these networks must be addressed first. Improved feeder roads are of no use if the secondary and primary roads cannot transport people and goods to markets, hospitals, schools, or to develop sound political and social networks.

The engineers and the economists on the feasibility study team, together with ADB and EA, must consider the most appropriate tool to estimate the net economic benefits from any road improvement project. In the Timor-Leste case, even though most roads had low-volume traffic, the use of Highway Development and Management Model (HDM-4) was agreed upon. HDM-4 is a widely used tool to design and evaluate road programs, but the data input requirements are high. Since it is so widely used and flexible, the consensus was that HDM-4 would be most useful to the Government as a planning
tool. In other contexts, models that are simpler to operate and better adapted to low-traffic-volume roads, such as the RED\textsuperscript{4} model, should be considered as an alternative to HDM-4.

C. Advanced Work to Be Done by the Feasibility Study

Once the approach and methods have been agreed upon, the consultants proceed to implement the planned work. The engineering assessment of the road network and the traffic counts need to be given top priority at the initial stage; and the EA staff should be included in the work to the extent possible to enable some capacity building to take place. Traffic counts and reviews of road conditions will need to be repeated on a regular basis by EA, perhaps as often as annually. Without regular updates on traffic flows and road conditions, it is impossible to update and revise the longer-term plans, or provide a good maintenance program.

\footnote{See Lebo, Jerry and Dieter Schelling (1999) Design and Appraisal of Rural Transportation Infrastructure: Ensuring Basic Access for Rural Communities, Technical Paper 496, The World Bank, Washington, D.C., USA, for a good discussion of the power of the RED model and the types of places where it should be applied instead of HDM-4. The paper also discusses different ways to perform an economic analysis of rural roads with very low traffic volumes and little available data.}
Understanding the macroeconomic condition of the country is also critical; this understanding enables the consultants to evaluate the resources available for the improvement and maintenance of the road network and the institutions that manage the network. An unstable macroeconomic environment is also a signal that the Government’s management of the overall economy is weak and, thus, the ability of the Government to devote resources to the road sector are likely to be more limited than what would usually be the case. The evaluation also shows how willing the Government is to expand funds available for road sector and road-related programs. This willingness is often critical in determining which policy recommendations make the most sense to transform the road sector into an engine for development. The Timor-Leste case shows that, because each country is different, the analysis of the macroeconomy is vital at the early stages of the feasibility study.

Developing an understanding of the Government’s and nongovernment organizations’ institutional capacity enables the feasibility study team to design programs that will best suit the institutional strengthening component of the program. The process takes time because the institutions are not often keen to reveal their shortcomings. Establishing good relations with Ministry staff and others in the Government helps the team understand the strengths and weaknesses of the institutions and of the staff. Moving to understanding how the private sector operates is essential, provided there is a private sector dealing with road maintenance and construction. This is also true of the local consulting sector. Again, this helps design the institutional strengthening component of the project.

This paper now moves to the feasibility study team’s findings and experience in Timor-Leste. Many details are omitted, but much of the country context remains because it is interwoven in the development of the roads program recommended by the feasibility study and ADB. Follow-on programs to ensure institutional strengthening, such as transferring HDM-4 to EA, were outside the scope of the feasibility study and, thus, were not covered by the program. Such programs need to be the subject of future grants and TA missions and will also depend on the country context and political developments.
As with any program and/or project, it is important for practitioners to understand the context in which they will be working. In the case of Timor-Leste, the project team conducted an analysis of the country before providing recommendations and collecting data. The country’s profile, organization structure, and overall history were analyzed and studied before moving forward to develop the roads program.

A. General Profile

Timor-Leste became independent in 2002, following 25 years of conflict. Devastated by the violent transition from Indonesian rule, the civil war left 70% of the physical infrastructure destroyed. Roads had not been maintained or repaired in years. Since independence, Timor-Leste has been engaged in nation building, and the focus has shifted from post-conflict reconstruction to sustainable growth and poverty reduction. As post-2005 events show, this is often a stop-and-go process in such fragile states.

By 2005, the Government had made progress in nation building, restoring public services, and promoting private sector activity. The new nation’s overall performance had been better than those of most post-conflict countries. However, the crisis in May 2006 has turned back the clock, and international peacekeepers are again in place at the time of this writing.

Timor-Leste is among the world’s poorest countries and lags behind the rest of the region in achieving the Millennium Development Goals (MDGs). Its population growth rate is among the highest in the world, and the unemployment rate for urban youth exceeds 40%. Likewise, the rates of rural unemployment and underemployment are high, but there are no reliable estimates available.
Rich in oil and gas reserves, Timor-Leste has established an offshore account to manage funds raised from the sale of these natural resources. The Government uses the US dollar as the national currency and, thus, has no independent monetary policy. Inflation is low and stable. Despite having 90% of the population in poverty, the Government manages a tight, or conservative, fiscal policy. Further, Timor-Leste has accepted no loans from international development institutions and only accepts grants. In this manner, the Government has avoided committing to any conditionality covenants with funding agencies. Timor-Leste has been slow to invest its own resources in infrastructure.

The official language is Portuguese. The two languages spoken by the vast majority of the population—Bahasa Indonesian and Tetum—were not accepted as the official languages. This leaves only about 2% of the population able to participate in the Parliament, as members of the Government, or as civil service staff. Portuguese is being taught in the nation’s public schools.

B. Road Network Management Framework

Timor-Leste’s vision was to improve key road assets in order to ensure maximum socioeconomic development and poverty reduction. An effective management framework was essential in achieving the Government’s vision and
objectives, thus Timor-Leste established laws, institutions, and development plans to manage the transport sector. After independence, the Ministry of Transport, Communications, and Public Works initially managed\(^5\) the road subsector. The institutional structure has since been improved so that sufficient institutional attention is being given to each of the infrastructure sectors.

**C. Road Network Management and Maintenance**

The Government is managing a degraded road network, which entails high costs for emergency repair work needed to keep it functional. Therefore, the Government set a 10-year vision\(^6\) toward which the feasibility study represented the first step. The study and recommendations address the improvements needed in the road network and the management aspects of the road system.

More specifically, the Government’s objectives for roads, bridges, and flood control are to

1. Identify the national, district, and rural road networks essential for the support of economic and social development;
2. Initiate policies within a legal and regulatory framework that improves quality of life, encourages private enterprises, and improves access and safety, particularly in impoverished areas;
3. Develop roads, bridges, and topologies of flood control that provide environmental protection and reverse existing ecological damage;
4. Ensure development and regulation for the safe circulation of transport;
5. Ensure that the transport infrastructure meets national defense needs;
6. Establish technical standards for a national road network;
7. Preserve existing road assets as the first priority through sustainable maintenance and long-term management plans for support systems;
8. Establish an institutional structure and develop technical and administrative capacity of Timor-Leste staff to manage, maintain, and improve the road network independent of expatriate support;

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\(^5\) Currently the Ministry of Public Works.

\(^6\) Vision stated in Timor-Leste’s Transport Sector Investment Program (2004).
(ix) Implement sustainable strategies for the maintenance of rural access roads; and
(x) Establish and implement erosion control measures to prevent damage to physical infrastructure and economically valuable property.

The Government’s management and maintenance of the road networks are lacking in several areas. It is important to identify these areas at the onset of the program, so that practitioners can work to address these failures throughout the life of the project and, over the longer run, measure progress that is being made in implementing the program.

**D. Business Environment**

The feasibility study team reviewed the business environment linked with the road sector, namely: (i) the contracting industry, including consultancy services; and (ii) transport services for passengers and freight.

1. **Road Contracting Industry**

The Government took the following positive steps: (i) contracted out and outsourced more maintenance jobs; (ii) eased the procurement processes and made them more transparent, although further improvements must be achieved, especially for smaller contracts; and (iii) opened up the banking sector to improve access to credit.

A number of contractors who specialized in roads and bridges were moving away from this subsector to go into building structures. There were not enough road projects to sustain the companies. Furthermore, a number of contracting companies had an excess supply of equipment. As more funds go to the road sector, the excess capacity of these firms will again be used in a competitive manner to rehabilitate and maintain roads under the Government’s contracting and supervision.

2. **Consultancy Services**

Consultancy for civil engineering projects, such as roads, buildings, and irrigation projects is still in its infancy in Timor-Leste. So far, most consultancy work has been performed by foreign companies (for bigger
projects financed by funding agencies), or directly by the Ministry (for the smaller projects financed by the Government). The few domestic consulting firms active in the road sector are small and intermittently staffed according to the projects that they are able to win. Their services include engineering design, supervision of works, and some management training (budgeting, producing bills of quantities, etc.). The road design work done so far has been performed by foreign consultants, while the local consultants provide support staff. The often very compressed time frame for these consultancies using foreign experts has resulted in limited transfer of knowledge.

At the time of the study the procurement process for consultants for government contracts regarding road jobs was not deemed transparent and did not include public notices: the Ministry in charge usually drew up a short list, and potential bidders received notification over the phone. This lack of formal documented procedures is thus secretive and unreliable. Furthermore, details on how the selection process was done are usually not provided. The procurement process, for international contracts, is deemed transparent and fair by East Timorese consulting firms. Depending on the size of the contract, the local consulting firms might (i) bid directly; (ii) form a joint-venture with an international company; or (iii) be a subcontractor to an international firm.

3. Contractors

Private companies were already commonly being used to implement infrastructure projects in Timor-Leste, in accordance with the Government’s strong priority to develop the private sector. There were more than 200 local civil engineering contractors in the country. The Transport Ministry classifies them into three groups, according to the size of the contracts that they are competent to undertake.

4. Transport Services

Transport service providers—passenger and freight transporters—represent key road users. They are critical to understanding how the expected benefits of any project will accrue to different stakeholder groups, such as the poor and very poor. Vehicle overloading was not an issue. Where traffic was relatively heavy, for example around Dili, competition between service providers was stronger than in rural areas.
5. Laws and Regulations

Most of the laws and regulations issued by the Government of Timor-Leste regarding the road subsector have dealt with passenger and freight transport systems. A rapidly changing transport market has made policy, regulatory, and institutional reforms within the Government all the more urgent. The establishment of the regulatory system has “officially” been guided by the “good” principles, such as the development of a transport sector and efficient use of scarce resources to ensure the sector is properly managed and maintained.

6. Passenger Transporters

Few statistics exist for inter-urban passenger transport, either in terms of passenger-kilometer (km) or in terms of number of passengers. The only centralized data produced by the Directorate of Land Transport (DLT) concerns the number of licenses for passenger transport. During fiscal year (FY) 2003/2004, DLT granted 580 new public transport licenses and renewed 2,726 licenses. The number of licenses granted by DLT has increased rapidly since 2001–2002.

The feasibility study team’s surveys and field observations collected some interesting data on the structure and performance of the passenger and freight transport markets. The information collected as part of the economic analysis found that the Government has set fares on all the main routes. Yet companies compete to get passengers on these main routes. They charge fares below what the Government has set where competition is stiff, and charge the fares set by the Government (or higher) on routes where there is less competition. The team’s surveys and observations from the social and poverty work confirm this conclusion, but found that the regulations were unheard of outside the two major cities.

7. Freight Transporters

Timor-Leste’s freight shipping sector is underdeveloped, and it was impossible to find any suppliers of freight shipping services outside of Dili. There are few factories or entrepreneurs that are large enough to use freight shipping services. The most common practice in Timor-Leste is to carry products in passenger vehicles, where the passengers pay extra fees to carry
goods (an especially common practice for small farmers and kiosk owners) or to use their own vehicles or rented vehicles to transport goods (as is the case for larger businesses).

No more than a dozen established companies specialize in freight transport. They are supplemented by (i) a large number of “one-man/one-small-truck” types of businesses; and (ii) a few nontransport-related companies, which use their vehicle fleets for their own individual businesses only (coffee exporters, main shops, major car dealers, and so forth). As a consequence of the low level of development of the freight transport industry, no centralized statistics existed as of 2005, either in terms of ton-km or even in terms of number of tons being carried.

8. Recommendations for Transport Services Development

The feasibility study team made several recommendations based on the analysis of the road transport services sector. These recommendations should assist the Government in ensuring that passenger and freight transporters work efficiently in order to provide the best services to road users. Similar recommendations may be applicable to other countries, but recommendations must be formulated after a project team conducts a detailed analysis of the country’s transport sector and the context in which it is operating. The Project team’s recommendations, in the case of Timor-Leste, were to

(i) Improve and expand existing regulations, especially in terms of (a) limiting the Government’s role to policymaking, sector regulation, and performance monitoring; (b) promoting maximum private sector participation; (c) ensuring appropriate safety and environmental standards; and (d) promoting the participation of all stakeholders in the transport planning process.

(ii) Gather transport-related data to produce nationwide statistics on passenger transport and freight transport systems.

(iii) Enforce laws and regulations to guarantee that (a) all vehicles are registered and accounted for. Therefore, owners will pay their registration fees; and (b) all vehicles will be safer because they are regularly checked.

(iv) Carry out a full-fledged road safety audit and improvement study.
(v) Ensure that competition is thriving in the industry.
(vi) Eliminate controls on freight rates and passenger fares.
(vii) Upgrade terminals for passenger transport so that the terminals can provide maximum comfort to passengers and some level of organization for transporters.
(viii) Improve the overall condition of roads.
(ix) Improve access to credit in secondary cities, especially for transport service entrepreneurs.
(x) Institute a Vehicle Fleet Transformation Program, starting with selling the Government’s surplus 4-wheel drives (4WDs), pickups, and jeeps that were donated by the United Nations and other aid agencies.\footnote{The need for the vehicle fleet transformation program became clear to the feasibility study team as a key recommendation to ensure that the fleet, dominated by funding agency-supplied 4-wheel-drive vehicles and unsuited for the development of Timor-Leste, is modified to a vehicle fleet more suited to the needs of the poor, and small farmers and businesses. The program, in brief, would require the Government to auction off all vehicles given to the Government by funding agencies. The funds from the auction would be used to purchase light trucks and buses that are more durable, easier to maintain, and more suited to the context of Timor-Leste. Combined with a microcredit program, the more suitable vehicles should then be sold to businesspeople who wish to work in the transport services market. The need for this program only became clear through the Social and Poverty Analysis that can be found in the Final Report of the feasibility study referenced above. Since the program is revenue-neutral, this will not require the Government to change its tight Fiscal Policy stance.}
Analysis of the Road Environment

A. Road Network Analysis

The core road network in Timor-Leste is 1,400 km of national roads and 800 km of district roads. This is a small national network when compared to those of many other countries in the region and worldwide. However, road density and the proportion of paved roads per capita are both relatively high given the population density and the level of economic development. The following section will provide a brief analysis of the road network to demonstrate to practitioners the importance of examining the current infrastructure within the country before proceeding with a project. The feasibility study team took the following steps in examining the road network:

- Measured the entire primary and secondary road networks using global positioning system (GPS),
- Determined the density of the network,
- Determined the classification of roads within the network,
- Determined surface type of the core road network,
- Examined present condition of all road networks, and
- Divided the core network into homogeneous sections.

The feasibility study team found that the road network is relatively dense for a country at a similar stage of development as Timor-Leste. The team found the network to be in overall poor condition, despite the investments implemented over the past several years. In other words, much has been done
According to Ministry data and the team’s survey, the overall network is more than 6,000 kilometers (km), of which the core network represents 2,217 km (1,400 km of national roads and 800 km of district roads). The remaining network consists of urban roads (roughly 700 km) and feeder (rural roads) (more than 3,000 km).


To reach the goal of making the main roads at least passable at low speeds. However, more needs to be done in order to complete this goal, as well as the ultimate goal of ensuring optimum conditions for the road network. Bridge washouts are common given the extreme topography and climate variations.

There is no official classification of roads as of 2005, although there is an attempt to organize the road network using a translation of an Indonesian manual. The core network totals 2,217 km of roads, or 38% of all roads. The core road network is made of national roads (24% of the total road network) and district roads (14% of the total road network).
Other roads within the road network include rural and urban roads. Rural roads (50% of the total road network) connect the subdistrict capitals to villages and the more remote areas that have agricultural potential. Urban roads (12% of the total road network) are defined as roads inside the towns and cities. However, these roads are sometimes included with the national or district roads they serve in order to get some of the funding dedicated to these roads.

The project team considers that the road network's density represents a burden given the country's current state of development and absorptive capacity. For the country, road density is 417 km per 1,000 square kilometers of land and 7.2 km per 1,000 persons. The highest density is, not surprisingly, in the Dili Region, due to the overwhelming economic weight of the capital city. Otherwise, the density of the road network is relatively homogeneous across the country.

The core road network (national and district roads) can be broken down between paved roads (asphalt concrete and surface treatment), and unsealed roads (gravel and earth roads) as referred to in Table 1.

### Table 1: Surface Type of the Core Road Network

<table>
<thead>
<tr>
<th>Road Network</th>
<th>National</th>
<th>District</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(km)</td>
<td>%</td>
<td>(km)</td>
</tr>
<tr>
<td>Paved</td>
<td></td>
<td></td>
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<tr>
<td>Asphalt Concrete</td>
<td>562</td>
<td>40</td>
<td>0</td>
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<tr>
<td>Surface Treatment</td>
<td>731</td>
<td>52</td>
<td>503</td>
</tr>
<tr>
<td>Unsealed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gravel</td>
<td>0</td>
<td>0</td>
<td>106</td>
</tr>
<tr>
<td>Earth</td>
<td>112</td>
<td>8</td>
<td>203</td>
</tr>
<tr>
<td>Total</td>
<td>1,405</td>
<td>100</td>
<td>812</td>
</tr>
</tbody>
</table>


All asphalt concrete roads are part of the national road network and were built—more expensively—in order to accommodate higher traffic levels. The national road network does not have any gravel roads, although it has more than 100 km of earth roads that used to be paved but have collapsed due to lack of maintenance. The rest of the national road network, slightly over half, is made of surface treatment roads amounting to 734 km. The district road network follows a different construction pattern: slightly more than 60% is paved (all surface treatment), while 13% is gravel and 25% dirt or mere tracks.
The present condition of all networks is generally poor except for the main axes from Dili or where new improvement schemes have been carried out. The team carried out a large number of traffic counts around the country and surveyed 1,600 km of roads, including all national roads. The outcomes of these surveys are summarized in Table 2.

### Table 2: General Surface Condition of the Core Road Network in 2005

<table>
<thead>
<tr>
<th>Road Network</th>
<th>National</th>
<th>District</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(km)</td>
<td>%</td>
<td>(km)</td>
</tr>
<tr>
<td>Total</td>
<td>1,405</td>
<td>812</td>
<td>2,217</td>
</tr>
<tr>
<td>A. Paved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good or fair</td>
<td>791</td>
<td>61</td>
<td>211</td>
</tr>
<tr>
<td>Poor or very poor</td>
<td>506</td>
<td>39</td>
<td>291</td>
</tr>
<tr>
<td>Subtotal (A)</td>
<td>1,297</td>
<td>100</td>
<td>502</td>
</tr>
<tr>
<td>B. Unsealed</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Good or fair</td>
<td>0</td>
<td>0</td>
<td>43</td>
</tr>
<tr>
<td>Poor or very poor</td>
<td>108</td>
<td>100</td>
<td>267</td>
</tr>
<tr>
<td>Subtotal (B)</td>
<td>108</td>
<td>100</td>
<td>310</td>
</tr>
</tbody>
</table>

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Most of the paved network is in good or fair condition (56%). However, there is a significant discrepancy depending on road classification: while 61% of paved national roads are in fair or good condition, this is the case for only 42% of district roads. Only 11% of the unsealed roads, which represent a small share of the network, are in good or fair condition. Authorities have not maintained these unsealed roads. Indeed, they are difficult and expensive to maintain given the topology and climate in Timor-Leste.

The team surveyed about a quarter of the 800-km district road network and carried out traffic counts on almost half of them. Except in a few instances, the overall road condition is poor or very poor, and the traffic levels are very low.

The team divided the core network into homogeneous sections. While attempting to minimize the number of sections in order to enhance the overall clarity of the analysis, the team ensured that these sections were homogeneous in terms of traffic patterns and engineering characteristics.
Analysis of the Road Environment

B. Demand for Transport Analyzed

For each of the homogeneous sections identified, the feasibility study team defined the demand for transport, or in other words, traffic levels. The demand analysis was performed in terms of

(i) Selecting and defining vehicle types representative of the country’s vehicle fleet;
(ii) Assessing average annual daily traffic; and
(iii) Forecasting traffic.

1. Vehicle Fleet

A vehicle fleet comprises a mix of several vehicle types that use a road network. The characteristics of the vehicle fleet are normally represented by grouping the vehicles into classes that the team defines according to common characteristics attributed to the vehicles. Such attributes include size, type of utilization, and performance of the vehicle. Each class is thus attributed a representative vehicle.

**BOX 2**

Following the analysis of the vehicle fleet in Timor-Leste, the team defined the following categories of motorized vehicle types, which were used as the basis for the traffic counts. The table shows the estimated total numbers, representing the stock of vehicles in Timor-Leste as of mid-2004.

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Estimated Total Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorcycles</td>
<td>11,012</td>
</tr>
<tr>
<td>Private cars and taxis</td>
<td>3,614</td>
</tr>
<tr>
<td>Jeeps and 4WDs</td>
<td>1,800</td>
</tr>
<tr>
<td>Pickups and vans</td>
<td>1,756</td>
</tr>
<tr>
<td>Micro- and minibuses (up to 20 seats)</td>
<td>1,547</td>
</tr>
<tr>
<td>Medium &amp; large buses (more than 20 seats)</td>
<td>200</td>
</tr>
<tr>
<td>Light trucks (less than 5 tons)</td>
<td>453</td>
</tr>
<tr>
<td>Medium trucks (5–10 tons)</td>
<td>1,714</td>
</tr>
<tr>
<td>Heavy, oil, and articulated trucks (more than 10 tons and 3 axles or more)</td>
<td>61</td>
</tr>
</tbody>
</table>

Because there was no heavy traffic in Timor-Leste, the heaviest categories of trucks have been grouped together for the sake of the economic analysis. Nonmotorized traffic is not considered in the economic analysis because it is relatively scarce and has little influence on traffic flow characteristics and, therefore, do not have a great impact on the economic results. Note that this would be different if the study focused on the tertiary and feeder roads.

The data pertaining to the vehicle fleet describe the characteristics of vehicles that use a road network. Vehicle fleet characteristics are required by HDM-4 for the estimation of traffic flows and road capacity, vehicle operating costs (VOCs), travel time costs, accident costs, and the evaluation of environmental effects from vehicle emissions and traffic noise.

2. Normal Traffic Estimated

Normal traffic, also referred to as annual average daily traffic (AADT), is defined as the traffic that uses a road under normal circumstances (assuming no change in maintenance policies, no new construction or rehabilitation projects changing traffic patterns, no landslides or dramatic failures that would make the road impassable, etc.).
A review of existing data in Timor-Leste showed scarce traffic data and, where it existed, was not consistent over the years and was considered unreliable. Therefore, the team completed a series of traffic counts at strategically located stations. Traffic counts were conducted in about 30 locations that were defined and prioritized so as to concentrate the team’s time and resources on the most valuable road sections, or in other words, on the Timor-Leste priority roads and other candidate roads as determined by the team. The traffic surveys, implemented between 1 March and 22 April 2005, serve as the basis for determining Average Daily Traffic (see Figure 1). Staff from the Ministry of Transport was included in the process as part of the capacity building goal of the feasibility study.

In order to go from average daily traffic (ADT) to AADT, the team assessed seasonal variations, taking into account the main factors driving changes in traffic patterns—the rainy season and the season for coffee production. In other countries, other factors may influence traffic patterns and have a negative or positive impact on traffic counts.

The rainy season has a direct impact on traffic patterns. Landslides and flooding, which are common during that season, cause frequent road closures. The team took into account these road closures by applying a seasonal variation factor, whose weight depended on the climate zone. The team defined three types of climate zones in Timor-Leste, mostly depending on altitude and rainfall levels: (i) areas with low rainfall had rain for an average of 4 months per year; (ii) areas with medium rainfall had rain for an average of 6 months per year; and (i) areas with heavy rainfall had rain for an average of 8 months per year. For road sections known to be impacted by the rainy season, the team consequently applied the following factors to average daily traffic as determined during the rainy season: (i) plus 33% for low-rainfall areas; (ii) plus 50% for medium-rainfall areas; and (iii) plus 67% for high-rainfall areas. Note that if the road was considered completely cut to traffic, preventing all normal traffic to pass, the additional traffic was considered as generated traffic.

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8 According to the World Bank 2004 Public Expenditure Review, about 44% of Timor-Leste lies between 100 and 500 meters above sea level and 35% more than 1,000 meters above sea level. This steep mountainous terrain is prone to erosion and landslides during heavy seasonal rains. In the coastal plains, roads are affected by flooding. In February 2003, during a "normal" wet season, nine of the 13 districts had one or more national and district roads closed or in danger of closure, while roads to at least 16 villages were closed and a further 13 were in danger—meaning only 4-wheel-drive vehicles could pass—so that the roads were effectively closed to other traffic. The road asset maintenance systems (RAMS) inventory indicates that 592 km of roads in hilly terrain are subject to landslides (47% of the inventoried network) and 124 km to flooding in the coastal plains.
Figure 1: Core Network with Traffic Counting Stations
The second factor affecting traffic patterns over the year is the location of coffee production and harvesting cycle. Five coffee-producing districts are concentrated in one area in Timor-Leste. The coffee is picked up by small trucks and is brought to two wet factories. They are then sent to another factory with a drier climate for drying and to Dili for processing and shipping. In the five “coffee districts”, the coffee harvest season extends roughly from April to September. Because the coffee season lasts half a year, the team deflated these traffic figures by half in order to obtain AADT.

The traffic composition depends on the road section and is mostly derived from the traffic counts that were carried out by the team. As a general rule, the team found that motorcycles (28% of AADT), light trucks (17% of AADT), medium trucks and minibuses (12% of AADT each), and 4WD and pickups (11% of AADT each) are the more common inter-urban traffic categories. Heavy trucks (1% of AADT), cars (3% of AADT), and large buses (5% of AADT) are not common in Timor-Leste in terms of inter-urban transport. The team assumed that the traffic composition would not change over the analysis period (10 years), although this likely will not be the case in the longer term. This reinforces the need for the Public Works Department to update the plan as conditions change.

3. Traffic Forecast

For a typical program analysis, traffic forecast is usually composed of (i) growth for normal traffic, which corresponds to the growth that would occur even without improving the road network; and (ii) generated traffic, which occurs only in case where there is a significant improvement in the road network.

The team based its forecast of normal traffic growth on the overall performance of the Timor-Leste economy, namely its gross domestic product (GDP) growth rate. The team used official GDP growth figures. The traffic growth rates for FY2005–2016 were subsequently based on an assumed elasticity for national transport demand relative to GDP growth of 1.2. This is derived from the team’s experience and is commonly used to assess traffic growth in data-scarce environments. Therefore, overall normal traffic growth is assumed to be 6% per year.

Some traffic is likely to be generated due to the road investment program given the overall poor condition of the road network in Timor-Leste. The team adopted a two-step method to assess generated traffic: (i) by approximating
the traffic on roads that were impassable at the time of the traffic counts through a basic network analysis of comparable roads; and (ii) by assuming that some level of traffic would be generated when a road was improved from very poor to good condition. To be conservative, the team did not estimate generated traffic when roads were ‘only’ in poor condition or were only slightly improved (e.g., to fair conditions).

First, the team analyzed the road sections where traffic was impassable. This analysis was done in order to determine what the traffic levels and compositions would be if the road was passable. The team then deducted the level of generated traffic at the opening of the road using the standard 6% growth rate, which was also applied for future growth patterns.

Second, the team assumed some generated traffic for all sections, in very poor overall condition (at least one of the criteria defining the road condition level between the ride quality and the surface condition has to be “very poor” and the other one “poor”) and for all the major construction options (which would bring up the condition level of the road to good condition). Generated traffic represents 30% of the levels of normal traffic when the road section is passable (only one of the road conditions criteria between ride quality and surface condition is “very poor”). When both criteria are “very poor”, then generated traffic was assumed to be 40% of normal traffic.
C. Maintenance and Upgrading Procedures

Maintenance is commonly divided into two categories: (i) routine maintenance and (ii) periodic maintenance. Maintenance policies depend on the type of roads—asphalt concrete, surface treatment, gravel, or earth.

For each of the maintenance policies, the team defined operations, such as patching or drainage, according to the following parameters: (i) the time of intervention—scheduled or responsive to external factors, such as traffic levels or condition of the road surface; (ii) some engineering characteristics of the intervention—e.g., the thickness of the pavement; (iii) the condition of the surface after the intervention; and (iv) the financial and economic unit costs. The team defined three main maintenance policies for the analysis.

A maintenance policy is made of several maintenance operations. For example, the minimum maintenance policy for a bituminous pavement could be made of routine maintenance operations, such as drainage, edge repair, and patching. On the one hand, an enhanced maintenance policy would mostly add to the minimum policy operations, such as crack sealing (for routine maintenance) and overlay or surface dressing (for periodic maintenance). The distinction between enhanced and ideal maintenance policies, on the other hand, stems chiefly from the frequency of interventions or from their level of quality (e.g., single-surface dressing versus double-surface dressing). The team defined nine such maintenance policies for the paved and unsealed road sections, including in the without-project scenario.

Bituminous roads are divided into surface treatment and asphalt concrete. Unsealed roads consist of gravel and earth roads. While gravel roads are intended to be this way, earth roads mostly correspond to formerly paved roads that badly deteriorated due to lack of maintenance.
Design Road Investment Program

A. Define Project Alternatives

Based on the definition of the road sections and the demand for transport, the Project team defined a set of alternatives, including the without-project situation to which all other alternatives are compared. All project alternatives comprise a maintenance policy, including the without-project scenario. This is essential; otherwise, the road section will certainly collapse over time. The with-project alternatives usually encompass higher-level maintenance and/or improvement interventions, such as rehabilitation, full reconstruction, or lane addition. Because of the general nature of the exercise—the Project team covered about 2,200 km of road—the alternatives are also quite general so that they could apply to a number of road sections.

B. Routine and Periodic Maintenance

The routine and periodic maintenance for the roads is summarized in Tables 3 and 4.

These maintenance policies were developed and tailored to the Timor-Leste context. The combinations of treatments will differ depending on the characteristics of the DMC under study.
### Table 3: Routine Maintenance Operations per Type of Roads

<table>
<thead>
<tr>
<th>Type of operations</th>
<th>Type of roads</th>
<th>Grading (when IRI &gt; 11)</th>
<th>Grading (when IRI &gt; 9)</th>
<th>Grading (when IRI &gt; 8)</th>
<th>Drainage (every year)</th>
<th>Edge repair (every 3 years)</th>
<th>Edge repair (every year)</th>
<th>Patching (every 3 years)</th>
<th>Patching (every year)</th>
<th>Crack Sealing (every year)</th>
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</thead>
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</table>

IRI = international roughness index.

Table 4: Periodic Maintenance Operations per Type of Roads

<table>
<thead>
<tr>
<th>Type of Operations</th>
<th>Type of roads</th>
<th>Regravelling when gravel &lt; 20 mm</th>
<th>Regravelling when gravel &lt; 30 mm</th>
<th>Surface dressing simple 15 mm when total damaged area &gt; 14%</th>
<th>Thin overlay 30 mm when IRI&gt;7</th>
<th>Double bituminous surface treatment 30 mm when total damaged area &gt; 14%</th>
<th>Overlay dense-graded asphalt 40 mm when IRI &gt;7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum maintenance policies</td>
<td>Earth roads</td>
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<td>Surface treatment roads</td>
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<td>Asphalt concrete roads</td>
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<td>✓</td>
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</tbody>
</table>

C. Improvement Policies

As for the maintenance policies, the team defined the improvement policies in terms of the time of intervention, engineering characteristics, condition after the intervention, and unit costs. The engineering characteristics of the improvement interventions, however, are much more developed compared to those of the maintenance operations. In general terms, the team defined new pavement types, as well as their surface materials and thickness. After an improvement intervention, the team has assumed that an “enhanced” level of maintenance would be performed on the road section. Improvement operations for each type of road are summarized in Table 5.

Table 5: Improvement Operations per Type of Roads

<table>
<thead>
<tr>
<th>Type of interventions</th>
<th>Type of roads</th>
<th>Upgrade to / Reconstruct Gravel</th>
<th>Upgrade to single surface treatment</th>
<th>Reconstruct surface treatment</th>
<th>Upgrade to asphalt concrete</th>
<th>Reconstruct asphalt concrete</th>
</tr>
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<tbody>
<tr>
<td>Earth roads</td>
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<tr>
<td>Gravel roads</td>
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<td>Surface treatment roads</td>
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</tbody>
</table>


D. Unit Cost of Interventions

Financial costs of maintenance operations and improvement interventions are based on average preliminary design estimates for the whole country. Financial costs include design and supervision costs. From these financial costs, the team calculated the economic costs of maintenance operations and improvement interventions.

1. Financial Costs

Financial unit costs are for (i) routine maintenance operations, (ii) periodic maintenance operations, and (iii) improvement interventions.
Financial costs for routine maintenance operations are (i) drainage: $1,174 per km; (ii) patching and edge repair: $9.62 per square meter (m²); and (iii) crack sealing: $3.07 per m².

Financial unit costs for the periodic maintenance operations, including preparatory works, are (i) regravelling (100[mm]): $25 per cubic meter; (ii) simple surface dressing (15 mm): $10.5 per m²; (iii) thin overlay (30 mm): $11.5 per m²; (iv) double bituminous surface treatment with shape correction (30 mm): $15.3 per m²; and (v) overlay dense-graded asphalt (40 mm): $17 per m².

Financial unit costs for the improvement interventions, including preparatory works, are (i) upgrade to or reconstruct gravel roads: $30,000 per km; (ii) upgrade to single-surface dressing: $80,000 per km; (iii) reconstruct surface treatment: $120,000 per km; (iv) reconstruct asphalt concrete: $140,000 per km; and (v) upgrade to asphalt concrete: $190,000 per km.

Because of the general nature of a program analysis and the necessity to reassess a more exact work policy at the project analysis stage, the periodic maintenance operations and improvement interventions described above can be aggregated in three main types of investment: (i) light, (ii) medium, and (iii) heavy. These types of investment vary according to the surface class of the road section, namely, if it is bituminous or unsealed, and can be classified as follows:

- For bituminous roads
  - Light investments—comprise relatively light periodic maintenance operations, such as surface dressing and thin overlay interventions. These periodic maintenance operations are typically less than $50,000 per km.
  - Medium-sized investments—comprise more substantial periodic maintenance operations, such as double bituminous surface dressing with shape correction and overlay dense-graded asphalt. These periodic maintenance operations are expected to run between $50,000 and $100,000 per km.
  - Heavy investments—encompass major rehabilitation interventions, such as (i) reconstructing the pavement and subgrade of surface treatment or asphalt concrete roads; or (ii) upgrading a surface treatment road into an asphalt concrete one. These heavy investments are all well above $100,000 per km.
• For unsealed roads
  
  o Light investments—comprise relatively light periodic maintenance operations, such as regravelling, which typically cost less than $20,000 per km.
  
  o Medium-sized investments—comprise heavier interventions, such as upgrading an earth road to gravel standard, including works on the road structure. These periodic maintenance operations are expected to run between $20,000 and $60,000 per km.
  
  o Heavy investments—encompass major work construction, such as upgrading gravel or an earth road to bituminous standard. These heavy investments cost more than $60,000 per km.

2. Economic Costs

In order to evaluate the economic costs of the project, the financial costs identified at market prices need to be adjusted using appropriate conversion factors and shadow pricing. These adjustments account for the effects of market structure imperfections, government interventions, as well as the opportunity costs of resources used. The analysis is performed in US dollars.
Costs are made up of nontradable goods and services (labor) (5% of total costs) and tradable goods (remaining 95% of total costs). The price of labor was converted to its border price equivalent by means of a conversion factor. Some tradable costs were originally expressed in domestic market prices and, therefore, needed to be converted to border prices, the common denominator. These costs represent 40% of total costs. The rest of the goods and services, representing 55% of total costs, were expressed directly at border prices.

A shadow wage rate factor is used to adjust for the opportunity cost of labor. In Timor-Leste, labor supply is in surplus, as persistent high unemployment and underemployment rates indicate. No official figure exists for a national unemployment rate in Timor-Leste, and even less for underemployment. However, nationwide, it can be roughly estimated that only about half the unskilled workforce is actually fully employed. This estimate also coincides with another important factor explaining the discrepancy between financial and economic costs—the official minimum wage versus the black market rates. For unskilled labor, the minimum wage is $80 per month. However, the black market rates are often about half that—and sometimes even lower. Consequently, based on the current unemployment and underemployment rates and on the discrepancy between official minimum wage and black market rates, the team estimated the shadow wage rate factor to be 0.5. Income tax
for the labor is not considered for this study because the majority of the labor hired for the project’s construction work is expected to be earning less than $100 per month (the level of income that would require the workers to file a tax return). This conversion factor was applied to the 5% of the project’s total financial cost, i.e., the cost of hiring labor for the construction and maintenance work.

 Tradable goods in domestic market prices were converted to border prices using a conversion factor of 0.88. This rate corresponds to an average import tax of 12.4%. For other tradable goods and services, no adjustments were made because financial prices were already expressed in terms of border prices.

<table>
<thead>
<tr>
<th>Table 6: Conversion Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
</tr>
<tr>
<td>Nontradable Labor</td>
</tr>
<tr>
<td>Tradable — Domestic market price</td>
</tr>
<tr>
<td>Tradable — Border price</td>
</tr>
</tbody>
</table>


E. Performing Project Analysis

After reviewing the general assumptions made for the economic evaluation, the paper describes user benefits derived by the implementation of projects for each road section—namely, vehicle operating costs and time savings—and presents the results of the analysis.

1. General Assumptions for the Economic Evaluation of Projects

The evaluation was performed over a 20-year analysis period, beginning in FY2005 (the base year). This takes into account all the benefits of the prospective projects. Over a 20-year period, these costs become minimal, irrespective of the investment size. The economic evaluation of the project compared the costs and benefits between the without and with-project scenarios.
The ‘enhanced’ and ‘ideal’ maintenance policies corresponding to the with-project scenarios are scheduled and, therefore, tested for every year of the analysis period. The improvement policies, which correspond to major construction or rehabilitation interventions, are triggered by factors linked with the condition of the road sections or the forecast level of traffic. After an improvement policy is implemented, the team assumed that an ‘enhanced’ maintenance policy would be applied. Improvement works for paved roads are all responsive to factors linked with the condition of the road sections or their forecast levels of traffic. For unsealed roads, improvement works were tested for every year (from FY2007 to FY2016), until they represented the best option in economic terms. The team assumed that improvement works would be completed after a 1-year period, at which point of time benefits are starting to accrue.

Costs and benefits are valued in constant prices that prevail during the base year of the project. In this respect, any expected change in the general price level is ignored. The team was not in a position to assess any significant changes in relative prices over the life of the project. Furthermore, cost estimates are economic costs, which means all taxes and transfers are taken out. Improvement costs include all associated costs, such as supervision, as well as other relevant economic costs. In order to be conservative in the analysis, no residual value was added to the economic benefits of the project after the 20-year analysis period.

The benefits are discounted using a 12% rate. It is necessary to discount the transport costs and benefits in each year of the analysis period to their value in the base year. This reflects the time value of money, represented by the opportunity cost of the capital invested in the road project. Discounting is performed by multiplying the cost in a given year by the discount factor for that year.

The net present value (NPV) is then calculated using the HDM-4 Model and by subtracting the discounted benefits from the discounted costs of the project (both in terms of improvement and maintenance). In the economic appraisal of road projects, benefits are derived mainly from savings in road user costs (savings in vehicle operating costs and, to some extent, in developing countries, time savings), but can also be derived from a reduction of future maintenance costs.

In addition to NPV, an economic internal rate of return (EIRR) is provided by the Model for each proposed investment. EIRR is defined as the discount rate that equalizes the present value of the project’s cost and benefit streams. Projects with high EIRR values are generally preferred, as this will give positive NPV at high discount rates.
2. User Benefits Defined

The main benefits are for road users in terms of vehicle operating cost savings and time savings. Benefits linked with a potential reduction of accidents were not considered due to lack of data. Proposed investments also have some effect on maintenance costs. However, this effect can be a benefit or an additional cost to the agency in charge of the road network depending on the road section.

3. VOC Savings Assumptions

VOCs are derived from the costs of (i) representative new vehicles, (ii) replacement tires, (iii) gas and diesel, (iv) lubricating oil, (v) maintenance labor, and (vi) crew wages. Some of the items included in the financial costs enumerated above are not economic costs, but transfer payments. Indeed, they transfer command over resources from one party to another without reducing or increasing the amount of resources available as a whole. In order to obtain economic VOC, the team stripped financial costs of their tax, levy, and subsidy items in order to obtain border prices.

Timor-Leste has three types of taxes and levies.9

- A 6% custom levy for all imported goods;
- A 6% value-added tax (VAT), which applies solely to imported goods, at their cost insurance and freight (CIF) price plus the abovementioned custom levy; and
- Special taxes, for goods considered as “selective”. The level of these special taxes differs according to the goods, although they all apply to the fiscal price of goods, that is, including the custom levy and VAT. The taxes considered for this study are the following: (i) gas and diesel: 6 cents per liter; (ii) motorcycles: 12% of fiscal price; and (iii) nonbusiness-related vehicles: 36% of fiscal price, plus 36% for each dollar above $20,000.

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9 According to these levels of levies and taxes, the team used the following conversion factors to assess the economic costs of the VOC inputs: (i) 0.54 for 4-wheel-drive vehicles; (ii) 0.59 for pickups; (iii) 0.61 for private cars; (iv) 0.71 for motorcycles; (v) 0.81 for gas and diesel fuel; and (vi) 0.89 for all categories of buses and trucks, and for lubricating oil.
4. Time Savings Assumptions

Time savings are based on the value of time. Value of time, as derived in the economic analysis, has two components: (i) working time and (ii) nonworking time. The value of working time during productive hours was derived from the per capita average income of $415 per year. The team assumed a 48-hour work week and 48 weeks of work per year. The hourly value of working time used in the analysis was, therefore, 18 cents. Nonworking value of time was estimated to be a quarter of the value of working time—or 4.5 cents per hour. This conservative assumption is commonly used to acknowledge that time is a valuable resource, even if time is not used to earn income.

These two values were used as inputs to the HDM-4 Model, along with other assumptions made on vehicle characteristics, to determine the value of time at a disaggregated level. Other vehicle characteristics considered were (i) annual km driven, (ii) working hours per year, (iii) percentage of private use of the vehicle, and (iv) work-related passenger-trips. The team did not use an average daily value of time per se in the economic analysis, but based on a typical day of 8 hours of work and 16 hours of ‘leisure’ or other time. As such, the team estimated that the daily value of time would be about $2.20 per person.

F. Investment Prioritization with Budget Constraints

In the case of Timor-Leste, budget constraints were evident and were addressed accordingly. The team used a two-step approach: the first step was to determine the best project for all the with-project alternatives studied for each of the 87 sections through NPV. The second step was to rank or prioritize these projects on individual road sections within the 10-year analysis period through the ratio of NPV to financial capital cost. This ratio is commonly used in case of budget constraints; it provides the team with the rate of return (monetary benefit) for each invested dollar. The project team used the following methods for prioritization of investments:

✓ Defined the budget constraints on the 10-year road investment program;
✓ Provided the results of the analysis, i.e., proposed investments for the 10-year period (2006–2015); and
✓ Conducted a sensitivity analysis to examine impact on the investment program of changing working assumptions.
In most developing countries, road maintenance is traditionally underfunded and road improvement is dependent on international financing. Timor-Leste is no exception. Also, many countries facing major changes in their economic development have a problem optimizing the use of available funding. Before assessing the budget constraint with which the proposed 10-year program will have to comply, the team studied the funding sources and the necessary expenditures for the 10-year period (from FY2000 to FY2009).

Existing sources of funding for the road subsector are (i) the national budget and (ii) funds from the funding agency community. In terms of total expenditures in the transport sector, including roads, civil aviation, and sea transport, the Consolidated Fund for East Timor (CFET), or the national budget, accounted for one third of expenditures in the period FY1999/2000 to FY2003/2004. CFET includes the Government’s own projects and counterpart funding for funding agency-assisted programs. According to the Budget Directorate of the Ministry of Planning and Finance, the national budget for improvement and maintenance of roads and bridges should reach $8 million in 2005/2006.

CFET and Japan were by far the most important external supporters of the transport sector, accounting for half of total spending (32% and 18%, respectively). Ongoing and currently approved/committed funding agency projects will disburse another $95 million over the next 5 years, thus providing for almost 50% of the proposed program. Japan, Germany, and the European Union have all made major commitments related to the program for the next 5 years. Some $57 million remains to be mobilized from the funding agency community, in addition to some $23 million more for CFET spending. According to the Government, “in the event that this level of funding is not available from donors on a grant basis, the Government will have to consider alternative funding arrangements, including additional CFET allocations, or a reduction in proposed expenditures for the transport sector.”

Past expenditures covered the basic infrastructure needs of the Timor-Leste road subsector, ensuring that the main arteries became passable. Future expenditures will have to improve the level of serviceability of the roads which, overall, are still in poor condition. Ongoing improvement and maintenance expenditures represent committed funds in the entire road subsector, mostly for the national and district networks (Table 7).\(^\text{10}\)

\(^{10}\) Expenditures include priority interventions for the 3,000 km of rural and farm access roads, which currently receive minimal or no maintenance.
Funding agency support for road infrastructure amounted to about $36 million over the last 5 years (up to FY2003/2004). This represents about two thirds of total expenditures in the road subsector, including improvement and maintenance interventions, and three quarters of improvement expenditures only. During 2003/2004, infrastructure-related transport expenditures were complemented by (i) policy, planning, and management expenditures; and (ii) road transportation systems expenditures. The former amounted to slightly more than $5 million; the latter, $1.5 million.

CFET involvement in improvement expenditures is likely to diminish as most new capital investments are planned to be financed by individual funding agencies and financial partners. Instead, CFET will increase its allocation of funds in maintenance expenditures. Committed maintenance and improvement expenditures in the road subsector, referred to as ongoing expenditures in the Transport Sector Investment Program (TSIP) and are summarized in Table 8.

In addition to road infrastructure-related expenditures, and over the period FY2004/2005 to 2008/2009, the Government and the funding agency community have committed $1.4 million (for policy, planning, and management) and $2.1 million (for transportation systems).

Figure 2 summarizes the trend of spent, committed, and proposed expenditures related to improvement and maintenance over a 10-year period (from FY1999/2000 to FY2008/2009).

### Table 7: Past Expenditures
(in $ million)

<table>
<thead>
<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Road and Bridge Construction and Rehabilitation</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Funding Agency Program</td>
<td>0.81</td>
<td>12.35</td>
<td>15.83</td>
<td>3.00</td>
<td>3.82</td>
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<tr>
<td>CFET Appropriations</td>
<td>3.50</td>
<td>4.00</td>
<td>—</td>
<td>0.66</td>
<td>3.48</td>
</tr>
<tr>
<td>Total Improvement</td>
<td>4.31</td>
<td>16.35</td>
<td>15.83</td>
<td>3.66</td>
<td>7.30</td>
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<tr>
<td>Road Maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFET Appropriations</td>
<td>1.00</td>
<td>1.50</td>
<td>2.29</td>
<td>3.15</td>
<td>1.44</td>
</tr>
</tbody>
</table>

FY = fiscal year; CFET = Consolidated Fund for East Timor.
Since funds are readily available for investment in the Timor-Leste road network and can cover all the optimum investments proposed, the budget constraints could be considered as ‘soft’. A ‘soft’ budget constraint means that the team was able to pick all the project alternatives with the highest

Table 8: Ongoing and Committed Expenditures
(in $ million)

<table>
<thead>
<tr>
<th>Program Category</th>
<th>FY 2004/05</th>
<th>FY 05/06</th>
<th>FY 06/07</th>
<th>FY 07/08</th>
<th>FY 08/09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road and Bridge Construction and Rehabilitation</td>
<td>7.91</td>
<td>9.95</td>
<td>10.93</td>
<td>4.43</td>
<td>0.35</td>
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<tr>
<td>Funding Agency Program</td>
<td>5.11</td>
<td>6.18</td>
<td>6.42</td>
<td>6.76</td>
<td>7.42</td>
</tr>
<tr>
<td>CFET Appropriations</td>
<td>13.02</td>
<td>16.13</td>
<td>17.35</td>
<td>11.19</td>
<td>7.77</td>
</tr>
<tr>
<td>Road Maintenance</td>
<td>1.23</td>
<td>1.52</td>
<td>1.82</td>
<td>2.23</td>
<td>2.68</td>
</tr>
<tr>
<td>Total Improvement</td>
<td>20.45</td>
<td>28.69</td>
<td>30.15</td>
<td>23.69</td>
<td>10.67</td>
</tr>
</tbody>
</table>


Figure 2: Total Expenditures

NPV—even if due to high capital cost NPV/FC could be considered as low. However, in some instances, investments on different road sections had to be spread over the years to avoid ‘investment crowding’. The team deemed it necessary to spread these investments over the 10-year analysis period in order to avoid exceeding the absorptive capacity of the country’s administrations and industries.

The budget constraints for the 10-year period of analysis were determined using the findings from the World Bank Public Expenditure Review dated July 2004, which looked at the minimum and maximum allocation of funds in the road sector for a 10-year period.

The team determined minimum and maximum road investment levels (road rehabilitation and periodic maintenance) for the periods (i) FY2007 to FY2009; (ii) FY2010 to FY2012; and (iii) FY2013 to FY2016 (Table 9). These investments are as follows:

- **High Case**
  - Short-term (3 years): $39.6 million from FY2007 to FY2009
  - Medium-term (3 years): $33.6 million from FY2010 to FY2012
  - Long-term (4 years): $32.4 million from FY2013 to FY2016

- **Low Case**
  - Short-term (3 years): $20.8 million from FY2007 to FY2009
  - Medium-term (3 years): $17.8 million from FY2010 to FY2012
  - Long-term (4 years): $17.2 million from FY2013 to FY2016

The team ensured that the proposed investment program would be within the range of minimum to maximum allocation of funds as shown in Table 9. The team also ensured that no proposed investment for a given year would exceed the maximum amount allocated for that year.

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11 In case of hard budgetary constraints, the analyst might have to downgrade some projects to less expensive alternatives than the one maximizing NPV. In this case, the prioritization method employs the incremental NPV over cost ratio as the ranking index, rather than the straightforward NPV over cost ratio. The HDM-IV Model can also be used for this purpose.
A road investment program spanning over 10 years cannot be limited to a pure economic exercise in a country, such as Timor-Leste, with substantial pockets of poverty and connectivity problems that the Government has to deal with. Long-term road investments should certainly benefit society as a whole—the economic aspects of a project—but should also aim at reducing poverty and ensuring that the country stays connected. Consequently, the team adapted the way it performed its economic analysis compared to a standard cost-benefit analysis. The team used the typical discount rate of 12% used for infrastructure projects for the base case, and placed some weights on social and connectivity variables in the HDM-4 Model. In effect, this process better takes into consideration the long-term benefits of projects and, therefore, the social aspects of development, allowing some projects to be feasible. The Base Case, thus, becomes the Optimal Case in the judgment of the feasibility study team.

The team proposed for investment within the 10-year program all the links that ensure the country remains connected. Timor-Leste has a dramatic topography, dominated by the Ramelau Mountains stretching across the island from the eastern to the western tip. The country also has a tropical
climate with extreme variations in rainfall and temperature regimes over short geographic distances. Furthermore, there are two annual seasons determined by the monsoon regime and, as with rainfall amounts; there are marked differences in the lengths of the monsoon and the dry seasons across the island. Finally, very few streams are perennial, but rather vacillate between dry streambeds and raging torrents. These topographic and climate factors tend to make investment more expensive and, therefore, less likely to be economically viable. However, because it is in the long-term interest of the country to stay connected, the team ensured in its investment program that the main axis would be open all year-round.

The team presents below the main results from the base case of the 10-year program analysis, as well as a series of maps showing the various types of investments proposed for the short, medium, and long term.

H. The 10-Year Program

According to the team’s assumptions for the base case, the outcome of the HDM-4 Model shows that $76 million should be invested in the core road network in Timor-Leste, both in terms of periodic maintenance and
rehabilitation. This investment would yield an NPV of almost $55 million. In other words, a $76 million investment program over the next 10 years, as the one proposed by the team, will cover its own costs and lead to a net economic benefit above these costs of $55 million.

The total amount of proposed investments is spread over three periods. For each of these periods, the team set the amount of proposed investments in between a minimum and maximum range, as determined by the budget constraint analysis. The total amount of investments proposed for the 10-year program is spread over the three periods as follows:

- **Short-term:** $32.9 million from FY2007 to FY2009
- **Medium-term:** $21.1 million from FY2010 to FY2012
- **Long-term:** $21.9 million from FY2013 to FY2016

The investment program proposed for the short term amounts to almost $33 million and is near the upper range of the budget constraint. The needs are pressing. Of the amount proposed for investment in the short term, almost $13 million is proposed for the first year, FY2007 (1 July 2007–30 June 2008), which is close to the budget ceiling of $13.2 million. The investments proposed for the first year, which can be considered as the investments to be implemented with the highest priority, are spread over Timor-Leste.

For the remainder of the short-term period, the team provided the following recommendations:

- For FY2008, the team proposed $9.6 million worth of investments in the core road network, mostly on national roads.
- For FY2009, the investment program calls for investments totaling $10.3 million.
- Finally, the team noted that for the short term, from FY2007 to FY2009, investments are well spread over the country.

Complementary to the short-term program summarized above, the medium-term program (from FY2010 through the end of FY2012) concentrates investments mostly in the northern part of the country. The medium-term program amounts to more than $21 million over the 3-year period. Finally, the long-term program is roughly $22 million, spread over
a 4-year period. It is made of smaller investments spread throughout the country, much like the short-term program. Twelve of the 22 road sections proposed for investment within this program are district roads.

1. Locations and Types of Investment Proposed

The locations and types of investments proposed for the periods FY2007 to FY2009 (short term), FY2010 to FY2012 (medium term), and FY2013 to FY2016 (long term) are shown in the following maps.

2. Rationale for Proposing Investments

The reasons for proposing the base case 10-year road investment program are threefold: (i) economic, for all the sections that provide an economic internal rate of return superior to 12%; (ii) social, for all the sections that benefit the poorest areas in the country; and (iii) connectivity, for all the sections for which the proposed investment would ensure that all parts of the country are physically integrated.

3. Recurrent Expenditures

Within road sector investments, road maintenance has too often been the ‘poor child’ in terms of budget allocations and capacity. It is important to keep in mind that the benefits expected from the implementation of the proposed road investment program depend on the implementation of adequate maintenance policies. If the 10-year road investment program is implemented as proposed, the recurrent expenditures would amount to $23 million from FY2007 to FY2016. These expenditures—also referred to as routine maintenance because they are implemented on a regular basis—are applied on the whole core network and average between $1.9 million and $2.5 million per year.

I. Analysis of Two Other Scenarios

The results of testing two other scenarios were analyzed by the team in order to supplement the base case: (i) a 10-year program based on purely economic grounds, using a 12% discount rate and no social or connectivity considerations; and (ii) a 10-year program using the 12% discount rate used in the base case, but in this scenario even more weight was placed on the social and connectivity factors in the HDM-4 software, to provide for more socially inclusive outcomes, and emphasizing even more heavily the connectivity factor.
Figure 3

TIMOR-LESTE
OPTIMAL CASE, SHORT-TERM PLAN, 2007–2009

Boundaries are not necessarily authoritative.
Figure 4

Map 7

Optimal Case, Medium-Term Plan, 2010–2012

Boundaries are not necessarily authoritative.

Timor-Leste

Indian Ocean

Pacific Ocean

South China Sea

Java Sea

Savu Sea

Strait of Wettar

Timor Sea

Kilometers

0 5 10 15 20 25

Maps

Figure 4

Road Sector Inv. (Inside).indd   51
6/15/2007   4:48:19 PM
1. “Pure” Economic Scenario

The pure economic scenario only uses economic factors to determine the viability and ranking of projects. In doing so, the team uses a standard 12% discount rate. According to the assumptions made by the team, the outcome of the HDM-4 Model shows that in pure economic terms $67 million should be invested in the core road network in Timor-Leste, both in terms of periodic maintenance and rehabilitation. This total investment amount is spread over the three periods, well in between the minimum and maximum budget limits, as previously determined by the budget constraint analysis. The 10-year road sector investment program is as follows:

- Short-term: $24.1 million from FY2007 to FY2009
- Medium-term: $21.2 million from FY2010 to FY2012
- Long-term: $21.7 million from FY2013 to FY2016

Overall NPV for the 10-year road sector investment program is almost $40 million.

2. Locations and Types of Investment Proposed (“Pure” Economic Scenario)

The locations and types of investments proposed for the short-term, medium-term, and long-term periods for the alternative road program using the “pure” economic scenario (FY2007 to FY2009 [short-term], FY2010 to FY2012 [medium-term], and FY2013 to FY2016 [long-term]) are shown in the following maps.

3. More Socially Oriented Scenario

The more socially oriented scenario also uses a 12% discount rate and emphasizes the social and connectivity factors even more than the base case. In this respect, this scenario could be considered as the ‘most optimistic’ road investment program proposed under the feasibility study. In this scenario, the team proposes $88 million worth of investment spread over the three periods as follows:

- Short-term: $37.9 million from FY2007 to FY2009
- Medium-term: $21.1 million from FY2010 to FY2012
- Long-term: $29.1 million from FY2013 to FY2016
Figure 6

Map 6

SHORT-TERM ECONOMIC CASE, 2007–2009

Boundaries are not necessarily authoritative.

07-0395f RM

Map 6

07-0395f RM
Figure 7

TIMOR-LESTE
MEDIUM-TERM ECONOMIC CASE, 2010–2012

Boundaries are not necessarily authoritative.

- Heavy Investment
- Light Investment
- National Capital
- District Capital
- City/Village
- National Road
- District Road
- District Boundary
- International Boundary

Legend:
- Heavy Investment
- Light Investment
- National Capital
- District Capital
- City/Village
- National Road
- District Road
- District Boundary
- International Boundary

Boundaries are not necessarily authoritative.

Figure 7
Figure 8

Boundaries are not necessarily authoritative.

Map 9
The investment program still is within the bounds of the budget constraints although (i) it is near the upper limit in the short and long terms; and (ii) it is slightly above the ceiling for 2 years out of 10. In the first year, the proposed investment program exceeds the budget constraint by $1.2 million ($14.4 million instead of the ceiling of $13.2 million). However, the team deemed this surplus as acceptable, in light of the ADB investment through a grant of all but $3.2 million of the investments financed in the first year of the program. Also, the proposed investment program exceeds the budget constraint in 2014 by $1.4 million, which the team also deemed acceptable because of the distant horizon of this surplus. Overall NPV for the more socially oriented 10-year road sector investment program is almost $98 million.

4. Locations and Types of Investment Proposed (More Socially Oriented Scenario)

The locations and types of investments proposed for the short-term, medium-term, and long-term periods for the more socially scenario program (FY2007 to FY2009 [short-term], FY2010 to FY2012 [medium-term], and FY2013 to FY2016 [long-term]) are shown in the following maps.
Figure 9

TIMOR-LESTE
SOCIALLY ORIENTED CASE, 2007–2009

Boundaries are not necessarily authoritative.
Figure 11

TIMOR-LESTE
SOCIA LLY ORIENTED CASE, 2010–2013

Boundaries are not necessarily authoritative.
Conclusions and Recommendations

Road sector planning and improvement in ADB’s Pacific DMCs is a complex process of institutional reform, capacity development, and a host of other activities. While this paper focuses on the planning process of the road network itself, health and competition in the transport services industry are equally important so that the benefits of a transport sector are shared among all segments of the society. This is also the only way the road sector can be used to spearhead sustainable socioeconomic development. Although not emphasized here, controlling the environmental impacts of road sector development is of paramount importance. This is addressed in the Environmental Assessment Chapter in the Final Feasibility Study Report.

The use of HDM-4 and the primary data collected by the feasibility study team produces a project analysis that provides a valuable and thorough assessment of the investment needs in the core road network over the 10-year period extending from FY2007 to FY2016. However, the proposed program can be altered and customized to meet the changing needs of the country. The program gives a fairly reliable estimate of the short-term investment needs in the priority roads—say up to FY2009—but should only be regarded as indicative for the subsequent years. This is especially true as far as the long-term project period is concerned (from FY2013 to FY2016). This is why the team also included the analyses of two other scenarios (i) a 10-year program based on purely economic grounds, using a 12% discount rate; and (ii) an even more socially oriented program also using the 12% discount rate but placing more weight on social and connectivity factors.
It is also important to note that the reliability of the results is determined by the quality of the inputs. It is critical, in this respect, that the Ministry of Transport gather HDM-compatible data regularly and then update the program as often as possible, ideally on a yearly basis. These updates include critical inputs, such as the (i) condition of the network; (ii) traffic levels; and (iii) cost estimates of interventions. Updates are especially relevant because of the present acute shortage of data regarding the core road network in Timor-Leste. In this context, and in spite of a number of surveys carried out by the team, the present program analysis should be regarded as preliminary.

Every 2 or 3 years, the structure of the model itself should be re-assessed in order to take into consideration the changes in the main patterns of the road network or to incorporate new intervention policies, both in terms of maintenance or major rehabilitation works. Another example of a structural change to the model would be to specify average costs for different types of roads in order to reflect that actual situation on the ground. The program analysis performed by HDM-4 is a useful and powerful tool for planning road investments, but only as long as the assumptions made are representative of the actual situation. The sectioning of the road network; the description of the investments proposed; or the engineering, traffic, and overall socioeconomic data used in the model must be realistic.
References


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About the Road Sector Investment Planning in the Pacific

Road sector planning and improvement in ADB’s Pacific developing member countries (DMCs) is a complex process of institutional reform, capacity development, and a host of other activities. This knowledge product examines the lessons learned from Timor-Leste road sector planning in the context of poverty reduction and sustainable development. ADB’s experience in Timor-Leste provides practitioners with pragmatic analytical tools and methods to develop necessary short-, medium-, and long-term road network plans, maintenance plans, and institutional strengthening. These tools, when properly applied, will enable ADB to assist the lesser-developed and Pacific Region DMCs manage a road sector that is better able to promote development and reduce poverty. While this paper focuses on the planning process of the road network itself, health and competition in the transport services industry are equally important so that the benefits of the improved road network are shared among all segments of the society.

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