Infrastructure Maintenance in LAC: The Costs of Neglect and Options for Improvement

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Main Report

by

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No. 16: Economic Policies and Performance under Alternative Trade Regimes: Latin America During the 80s, April 1992.
TABLE OF CONTENTS

I. INTRODUCTION ............................................ [ 1 ]
   Objectives ........................................................ [ 1 ]
   Background ........................................................... [ 2 ]
   Overview of the Region's Infrastructure .................... [ 2 ]

II. CAUSES OF THE PROBLEM ...................................... [ 7 ]
   Institutional/Managerial ........................................... [ 7 ]
   Operational Problems .............................................. [ 9 ]
   Prices and Financial Problems ................................... [ 12 ]

III. AN AGENDA FOR IMPROVING MAINTENANCE .................. [ 15 ]
   Improving Operational Efficiency ................................ [ 15 ]
   Improving Pricing, Planning, Programming and Budgeting ....... [ 19 ]
   Ensuring Adequate Pricing and Increased and Reliable Funding ........ [ 22 ]

IV. THE ROLE OF THE BANK AND OTHER LENDING AGENCIES ...... [ 27 ]
   Donor Role in Disseminating Information About Infrastructure Maintenance ........ [ 27 ]
   Donor Role in Facilitating Adequate Funding .................. [ 27 ]
   Donor Role in Improving Maintenance Management and Execution ........ [ 28 ]

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I. INTRODUCTION

Objectives

1. The objective of this paper is threefold:

(a) To bring to the attention of Senior Managers, both within the Bank and the LAC countries, the dimension of LAC’s infrastructure maintenance problems, their financial, economic and social costs and the quantitative and qualitative benefits of adequate maintenance;

(b) To document and analyze the institutional, technical, policy and operational changes needed to improve infrastructure maintenance and to present an analysis of the options for improvement, with lessons drawn from success cases both in LAC and selected developed countries, including the United States, Spain, France, UK and Canada; and

(c) To identify the role of lending agencies in improving maintenance in LAC and to present a framework for future dialogue between the Bank’s senior managers and key planning and finance ministry officials as well as between LAC operational staff and their counterparts in the borrowing countries.

2. The paper deals with the roads, power, and water and sanitation sectors separately. The road sector was selected for transport because it is by far the most predominant mode and because the study’s findings and recommendations for the power and water sectors would apply in general to railways, ports, water transport and airports, which are also revenue-earning public utilities. More detailed discussions and supporting data are provided in three separate sectoral volumes and the fourth volume on routine maintenance by contract. The paper’s analysis is based on both field and desk studies conducted by a Study Group from the Latin America and Caribbean Technical Department, Infrastructure and Energy Division (LATIE) with consultants’ assistance. OLADE participated in financing consultants to carry out the field analysis for the power sector in two LAC countries and in providing valuable comments. The members of the Group or its consultants visited Argentina, Bolivia, Brazil, Chile, Colombia, Dominican Republic, Guyana, Honduras, Jamaica, Panama, and Venezuela. The paper also draws extensively from the Bank Group’s past experience in the LAC countries and its knowledge of the progress in the infrastructure sectors in the more developed countries including the USA, Canada, France, UK and Spain.

3. In this paper, maintenance is conceived as that set of activities which enables systems to deliver efficiently the outputs for which they were designed. Therefore, maintenance covers the upkeep not only of the physical infrastructure
but also of the management systems and institutional capacity necessary to obtain the maximum benefits from this infrastructure.

**Background**

4. The decade of the 1990s holds promises and new opportunities for economic and social transformation that should signal a better future for many in the Latin America and the Caribbean region. The 1990s, however, will not be an easy decade for regional development. A gradual return to the average annual growth rate path of between 5 to 6% per annum, achieved in the 20 years spanning 1960 to 1980 will require a major effort. The difficulties of reversing the main economic policies associated with the debt crisis, macroeconomic imbalances, inflation and the fall in production and real income of the last decade should not be underestimated, and will be formidable.

5. The 1980s were marked not only by a drastic decline in output in real income but also by sharp declines in net investment in and the neglect of the maintenance of capital infrastructure. During the two previous decades, the regional net investment coefficient averaged around 22% and reached a high of 25% of the regional product in 1990. In the 1980s, this situation drastically changed: the region's net investment coefficient dropped from nearly 23% in 1980 to about 17% in 1989. Not all countries were affected equally; in general though, net potential investment resources shrank resulting in drastic investment cuts.

6. Those countries that implemented sound policy reforms early on are now beginning to reap the benefits. There have been, of course, some setbacks and there likely will be more in the future; even so, real progress has been made in building a solid base for appropriate macro economic management. Countries such as Chile, Mexico, Costa Rica, Colombia, Jamaica, Ecuador, Bolivia and Venezuela are now gradually beginning to reap the fruits of the reform efforts initiated during the mid 1980s. Much still has to be done, but there is cause to look towards the future with optimism, albeit a cautious one. The 1980s may well be remembered as the decade when many countries in the region made a historic turnaround and began to set the stage for more sustainable growth. In many LAC countries, the opening of this decade offers dramatic new opportunities for investment and growth.

**Overview of the Region’s Infrastructure**

7. As is the case in all countries, infrastructure in the LAC countries represents both a very important element to ensure economic growth and a potential bottleneck if it deficient. The deficiencies are currently very high. Out of the total population of some 420 million (in 1989), 18% had no access to public water supply and 42% did not have sanitation facilities. To meet the needs of these people and of about 90 million more from expected population
growth, an annual investments of about US$10 billion are needed throughout this decade.

8. Some 30% of the region’s population lack electricity service. The investments requirements to maintain that coverage in the year 2000 is estimated at US$62 billion. If service coverage were to increase to around 80%, with close to 23 million new residential customers, corresponding investments would be about US$120 billion or an average of US$13 billion per year.

9. LAC countries in the aggregate have some 2.2 million km of roads with a replacement cost estimated conservatively at about US$96 billion. The networks, built at high cost during the boom years of the 1960s and early 1970s, are adequate to provide accessibility, but have deteriorated badly. Based on an analysis of the road network conditions and prevailing costs of remedial works in LAC counties, the total spending necessary to repair the network and prevent its further deterioration is conservatively estimated at about US$2.5 billion per year over the next decade (about US$1.4 billion for maintenance and US$1.1 billion for rehabilitation). Another US$4 billion a year would be required for upgrading the network to efficiently carry current and projected traffic over the same period for a total of US$6.5 billion per year.

10. All available evidence indicates that LAC’s physical infrastructure because of its critically deteriorated state is fast becoming the "third deficit" after those in the balance of payments and human resources. Service unreliability in both power and water and sewerage systems, high levels of electricity and water losses, poor quality of electric and water services, high generation costs for electricity, and poor road conditions—both in riding quality, passability and structural strength—are all manifestations of maintenance neglect.

11. The costs of this neglect are high and multi-dimensional: economic, financial and social (Box 1). Economic costs occur, for example, when overall production decreases as a result of frequent random interruptions in power or water supply or operating funds have to be diverted to build new capacity to compensate for low efficiency of existing facilities due to maintenance neglect. Financial costs are incurred when premature deterioration of assets increases operating costs of utilities or vehicle operating costs on roads. These costs have social/equity implications too. The poor suffer the most from bad service, as they often lack the resources to compensate for an anomalous situation or the political power to influence the allocation of resources, or suffer higher vehicle operating costs, and therefore transport costs, as rural communities are the first to be from road maintenance budgets. Energy, overall, is a major contributor to global pollution. In terms of the increasing accumulation of greenhouse gases, the energy sector’s share is estimated at about 49 percent of the total from all sources (WRI 1991). Inefficient generation heat rates in thermal systems, high electricity losses, and low service reliability contribute, in some cases, up to 37 percent of the energy related pollution load.
12. The exact magnitude of the cost of the degradation of the capital infrastructure stock is
difficult to estimate and is beyond the scope of this study. Available estimates indicate,
however, that they are substantial. For example, in the power sector, maintenance
neglect is roughly estimated to result in about US$360 million a year in higher thermal generation
3 costs, US$920 million in electricity losses (technical and non-technical) and another
US$580 million in lost sales revenue due to power outages, for a total of US$1.9 billion a
year in these three areas alone. This conservative estimate does not include the costs to users of
the unserved energy, the cost which is at least five to ten times the lost revenue to the utility.
Pervasive problems with the quality of the service provided to consumers, which suffers
constant interruptions and voltage fluctuations, are a further testimony of the infrastructure
degradation in LAC. The costs in the water and sanitation sector are of an equal magnitude.
Available data indicates that, on a regional basis, water sector companies are losing some
US$1.0 to 1.5 billion annually in revenues and additional operating

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<th>Economic Costs</th>
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| * Need to build new capacity (by the utility, and by users) to compensate for the decline
  in the availability and reliability of the existing one. |
| * Need to use scarce foreign exchange to pay for additional generation fuels (or export less
  hydrocarbons in the case of oil exporting countries) and for fixed assets and vehicle
  renewal. |
| * Sustained productivity and economic losses suffered by electricity and water users due to
  random interruptions and load shedding in electricity supply. |

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<th>Financial Costs</th>
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| * Premature deterioration of assets increases operational costs for utilities, reducing their
  operating margins. |
| * High non-technical losses reduce sales revenue and increase O&M costs associated with higher
  water supply and electricity and power requirements. |
| * Users must purchase back-up equipment to compensate for intermittent supplies. |
| * Premature reconstruction of roads. |

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<th>Social and Environmental Costs</th>
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| * Users in poor rural areas, or in poor residential neighborhoods in cities, are the first
  ones to suffer when capacity shortages occur both in water and electricity services. |
| * Poor households, small businesses and industries suffer the most as they often lack
  resources to compensate for unreliable service. |
| * Consumers are often required to pay higher rates to compensate for system inefficiencies. |
| * Rural roads are the first to be neglected when funds are short. |
| * Poor O&M practices in thermal generation systems contribute significantly to energy
  related pollution, in some cases by more than a third from levels produced under efficient
  conditions. |

Box 1: Types of Costs due to Maintenance Neglect

1. Given the urgency of the subject matter of the paper, its scope—covering three infrastructure sectors and all the countries in LAC— it was decided to work with available data and not wait to generate new ones. It was felt that the problem was sufficiently obvious and the manifestations visible, that the greater need was to get the message out rather than to carry out time-consuming surveys and/or measurement campaigns.
costs from avoidable commercial and technical losses directly attributable to deficiencies in maintenance and operations practices. The most recent regionwide survey in LAC shows that only about 27% of roads are in good shape. The losses in increased vehicle operating costs and premature reconstruction of badly deteriorated roads have been researched for selected developing countries (including Chile and Costa Rica in LAC) by the Bank with the sobering finding that each dollar not spent on needed road maintenance can result in an increase in vehicle operating costs of about three dollars, and an additional two to three dollars for premature reconstruction. For some LAC countries such road subsector losses amount to nearly 4% of GDP or US$1.7 billion annually in absolute terms. Together, these losses which amount to some US$4.6 billion annually far exceed the US$3.0 billion annual Bank lending for infrastructure to all LAC Borrowers.

13. These costs deal only with quantifiable losses; the unquantifiable ones can be equally telling. For example, the recent cholera epidemic in Peru is a tragic testimony to years of neglect of the water and sanitation infrastructure although its effects are unquantifiable in monetary terms. Likewise for roads, the high loss in lives due to adverse road surface conditions—slipperiness on unpaved roads and extensive potholes on paved roads—is the combined effect of neglected maintenance and the notoriously poor driving habits of motorists in LAC.

14. Unfortunately, available evidence suggests that decisionmakers inside and outside the infrastructure sectors do not appreciate sufficiently the dimensions of the economic and financial consequences associated with maintenance neglect. A major problem with maintenance is its lack of visibility and the fact that the consequences of maintenance neglect initially are often not very perceptible. Also, maintenance spending does not generate the enthusiasm associated with new capital projects and, along with its invisibility, is not politically or professionally compelling. Yet, ex-post evaluation of project financed by the World Bank Group has clearly demonstrated that infrastructure rehabilitation and maintenance have yielded much higher economic returns than new construction or upgrading. In the roads sector, the former activities have yielded an average of about 70% compared to a less than 25% average for the latter.
15. For the region to achieve sustainable growth, it will need to overcome many years of capital infrastructure neglect through reconstruction, rehabilitation and proper maintenance. Improvement in this area alone will not remove all obstacles to the region's development; however, without substantial progress in this regard, the region's economic recovery will be greatly impeded. Hence, it may not be a sufficient condition, but it is certainly a necessary one.
II. CAUSES OF THE PROBLEM

16. Several factors have contributed to the poor state of infrastructure and the deterioration of service in LAC. An assessment of the factors that led to the current situation is required before considering alternatives to overcome the problem. These factors are grouped under the headings "managerial", "operational" and "financial" (Box 3). Nearly all of them can, however, be subsumed under the heading "managerial".

Institutional/Managerial

17. Institutional/managerial problems are the root causes for the weak finances of the power and water sectors, as well as poor operating practices, lack of proper maintenance and unreliable service afflicting all infrastructure sectors.

18. In most LAC countries, local governments are in charge, either directly or through a specialized agency, of water and

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<th>Institutional and Managerial</th>
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<tr>
<td>* Conflicting roles of government, regulatory agencies, local government agencies and utilities.</td>
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<td>* Lack of corporate autonomy for expenditures and labor decisions and political interference in the day to day running of the industry.</td>
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<td>* Obstacles for private sector participation in the O&amp;M function.</td>
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<td>* Poor image of the O&amp;M function and uncertainties about the benefits of adequate maintenance.</td>
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<td>* Shortage of experienced managers and skilled technicians.</td>
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<th>Operational</th>
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<td>* Inadequate information on systems and costs.</td>
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<td>* Lack of planning.</td>
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<td>* Misplaced priorities due to lack of adequate evaluation of investments.</td>
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<td>* Unclear management objectives which lead to operate equipment above technically recommended parameters and without proper respect for scheduled maintenance, contributing to equipment failures and premature aging.</td>
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<td>* Poor operational practices.</td>
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<td>* Inadequate levels of maintenance expenditures.</td>
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<td>* Inappropriate technology.</td>
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<td>* Faulty and/or non-economic equipment designs, inadequate control of operations and use of indicators of performance.</td>
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<td>* Inadequate understanding of technical options for maintenance intervention.</td>
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<td>* Low productivity of force account operations.</td>
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<td>* Lack of performance monitoring and operation.</td>
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<th>Budgeting/Financial</th>
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<td>* Tariffs below operating unit costs and long-run costs of supply lead to insufficient generation of financial resources to cover costs and an overinflated market demand.</td>
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<td>* Inadequate cost recovery policies that fail to generate adequate financial resources.</td>
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<td>* Improper budget preparation.</td>
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<td>* Unhealthy dependency on central budgets and insufficient budgetary funds.</td>
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<td>* Incorrect allocation of available funds to the various maintenance activities.</td>
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Box 3: Causes of Maintenance Neglect
sanitation services and electricity distribution. In the case of roads, the central government is invariably in charge of national roads, with responsibility for local roads often delegated to the local authorities. The electricity and water/sanitation utilities, with some exceptions, and all main roads in LAC are government-owned. For the utilities, the role of the central and regional governments is more related to policy aspects, regulation of services and the provision of some [or all] of the funds for investment and operations. Central-local government relations, therefore, play a crucial role in operations and maintenance (O&M). However, the regulatory function of central authorities has been ineffective in most countries in promoting efficiency in operations and in obtaining reliable information to support investment decisions. For the roads subsector, practically all the important decisions are in central headquarters. By its nature, proper maintenance becomes the sum of widely scattered activities that require continuous monitoring and timely intervention. Those closer to the actual maintenance environment are more likely to handle it better. Maintenance needs receive very little attention in the central allocation of resources because decision makers at the center are too far removed from operational realities at the local level; therefore the signals and support from the center have been erratic or contradictory at times with respect to policies related to maintenance. New investment continues to receive more support from headquarters than investment directed at rehabilitation.

19. Lack of corporate autonomy for expenditures and labor decisions and political interference in the day-to-day running of the utilities have hampered their agility in reacting to real needs, in hiring the most qualified staff and in trimming the labor force to its optimal size. This loss of autonomy has been encouraged by the utilities' loss of financial independence as they have grown to depend on government subsidies. Road agencies, on the other hand, are saddled with civil service constraints that limit salaries to civil service norms, remove management's ability to lay off redundant staff and, equally importantly, require extremely cumbersome and time-consuming procurement procedures.

20. To accomplish their overall mission of developing and maintaining adequate infrastructure and providing efficient service at the lowest cost, most LAC utilities and road agencies use their own employees. Yet, in the few countries, such as Brazil, Colombia and Jamaica (roads) and Chile (water supply, EMOS) in which substantial operations and maintenance activities have been carried out by contract with the private sector, experience has demonstrated a clear advantage in cost-effectiveness of contracted works. Utilities and road agencies' apprehension over possible loss of power and resources and what to do with redundant staff, labor force and equipment and the fear of collusion or monopolistic tendencies by contractors, has so far prevented LAC utilities and agencies from using contractors on a large scale for operations and management.
21. Maintenance does not invoke the gratification that an intricate engineering design or the construction of a monumental work do. Therefore, even when utilities and road agencies have a free hand in the allocation of resources, they favor new construction. As a consequence, the better educated and more ambitious staff have shifted away from maintenance as a potential area for a promising career. Moreover, maintenance has been the item to cut during periods of restrained budgets, since it has had no political attraction and therefore little support.

22. The dearth of sufficiently-trained managers and skilled technicians has been a major constraint on efficient maintenance in all infrastructure sectors. The high turnover in managerial positions impairs institutional memory and compromises long-term plans and strategies, which affect the maintenance function the most. In-transit managers are not usually interested in the development and implementation of plans such as maintenance, that bear fruit in the long-term. Lack of competitive salaries, inadequate personnel policies that fail to attract and retain competent managers and technicians, and the lack of formal training are also factors that work against good maintenance. In the roads subsector, the situation has somewhat improved with the introduction of more analytical, computer-based maintenance management systems as well as the increasing emphasis now being given to maintenance by LAC governments in their official proclamations. Hence the Bank's Highway Design and Maintenance Standards Model (HDM) and the companion Expenditure Budgeting Model (EBM) have helped greatly in giving professional status and prestige to maintenance staff working with them.

Operational Problems

23. Maintenance of capital infrastructure should be viewed as one phase in the design-construction-operation process. New equipment or facilities can and should be designed and built for ease of operation and maintenance (Box 4). Timely repairs reduce long-term operating costs and ensure the full life expectancy of existing facilities and equipment. Innovative operations sometimes can add capacity at little cost as well as reduce maintenance needs. On the other hand, poorly trained staff often exacerbate maintenance problems; this is the case when water treatment plant operators fail to apply the right chemical dosages accelerating the problems of scaling and corrosion of pipes and meters, which demands on maintenance; or when electricity distribution workers sometimes take 10 times the normal time to repair a circuit breakdown; or when road crews fill potholes with any available materials. While standards and manuals for maintenance exist in industrialized countries, they are not widely known or used by infrastructure sector institutions in the region.

24. Maintenance staff is seldom taken into account in project planning, and designers often are not knowledgeable about operations. As a result, many facilities have been built without considering the capacity of institutions to
operate and maintain them. Inappropriate designs for facilities include selecting state-of-the art equipment but failing to take into account the human resources and funds needed to maintain and operate it. Failure to account for difficulties in importing spare parts for maintenance equipment can also lead to a precarious reliance on such equipment which cannot be properly maintained and soon falls into disrepair.

25. Management often sees maintenance as a series of problems to be handled as the situation arises, i.e., "fire fighting," instead of developing a program that includes plans for future needs. Methods for issuing and tracking preventive and corrective maintenance are frequently inadequate. Preventive maintenance is not viewed as the key element of the program but rather as "breakdown maintenance." The backbone of proper maintenance is a need-based, activity-prioritized maintenance plan and program. Reliable information on the condition, use and efficiency of the system and on costs and a systematic criteria for prioritizing and programming operations are an essential basis for preparing such a plan. Very few LAC utilities or road agencies have such systems in place, and are therefore forced to use time-hallowed, but ineffective maintenance intervention policies. For roads, for example, agencies are spending more than two-thirds of their maintenance budgets on routine maintenance and a third on periodic maintenance whereas a rigorous systematic analysis, based on reliable data and a better understanding of the technical options, would normally indicate the inverse.

26. Arguably, the most important cause of infrastructure maintenance problems is the inefficiency in the execution of works. Most LAC utilities and road agencies carry out their maintenance predominantly by force account. By whatever indicator or measure used, implementation efficiency in LAC is less than half that is obtained in more developed countries, especially if maintenance...
is carried out by contract. It is also not uncommon, for example, to observe O&M crews in the field using improper procedures because of lack of training, proper tools, equipment or materials. A management audit of the water and sanitation sector in Costa Rica [1990], for instance, revealed that field crews were losing 50 percent of their time from bad organization and an additional 20 percent from inadequate tools or methods. In the road agencies, equipment utilization rates, crew productivity, quality of works and cost effectiveness are all very low (Box 5). Decades of assistance from lending agencies and other donors to improve force account operations in maintenance have yielded very few success stories. On the other hand, the few utilities and road agencies in LAC that have contracted a significant portion of their O&M functions, for water supply and sewerage (such as Chile), and for roads (Brazil, Columbia and Belize), have shown marked increases in cost effectiveness.

27. Accountability is weak, both internally within the utilities and road agencies and externally to the public. The delegation of responsibilities from the government to the infrastructure agencies is often not followed by delegating the necessary authority and power to recover costs and mobilize resources to sustain O&M. Under these circumstances, it is difficult to hold the utilities totally accountable for performance. In the roads subsector, accountability is particularly weak. The road transport cost increases resulting from poor road maintenance are borne by road-users in the form of higher vehicle operating costs; agencies are not directly affected and therefore perceive no great incentive to improve conditions except under strong popular political pressure, which is rare in LAC.

28. Internal accountability rarely extends beyond financial audits and generally does not include performance monitoring of previously agreed physical targets. In the case of external accountability, since the agencies are chronically underfunded, either from government’s constraints on adequate cost recovery
or from insufficient budgetary allocations, the governments find it difficult to insist on performance reviews, especially since the approved tariffs or budgets are often not tied to any specific work program. Also, although most LAC agencies publish annual reports of their activities, both for Government and public consumption, they do not compare needs with revenues or budgetary allocations and performance. Lastly, interest groups, often co-opted by the agencies to give much-needed political support for their tariff increase applications or maintenance budget proposals, usually have not seriously evaluated the agencies’ efficiency and performance and have therefore not brought any pressure to bear on them.

**Prices and Financial Problems**

29. One of the immediate causes for maintenance neglect in the utilities has been lack of financial resources. When tariffs are sufficient to cover costs and provide an adequate return on assets, maintenance has a higher probability of being carried out than when there are financial constraints. The declining trend in the operating margins of the electric and water sectors has led utilities to develop an unhealthy dependency on the central budget for funds. This dependency increased the power of the government, making expenditure, investment and financial planning at the public utility level erratic and inefficient and, by reducing accountability, undermining attempts, to improve O&M.

30. From the point of view of finance, the most important elements affecting the profit and return on assets of the utilities are prices and costs. In the power sector, real tariff rates in LAC have experienced a steady decline since 1972. However, unit costs did not decline reducing the operative margin. Electricity and water rates in the LAC region have not reflected supply costs or kept pace with inflation. Between 1972 and 1988, the unit cost of 1 MWh of electricity (in 1989 US dollars) increased from $36 to $41—that is, 1 percent p.a.—whereas the unit price of 1 MWh of electricity fell from $63 to $49—that is, 1.6 percent p.a. As a consequence of the evolution of unit prices and unit costs during the last two decades, the difference between them left an operating margin for the region, in absolute terms, of US$8 per MWh in 1988, which was significantly less than the margin of US$27 per MWh in 1972 and explains in part the significant deterioration of the rate of return obtained by the sector.

31. This deterioration of sector finances was not the result of inefficiency, because unit costs were held basically constant for the power and water sectors. The main cause was the decline in tariff rates, testimony of the tendency of the governments in the region to use electricity prices as another policy tool. Tariff rates have shown resilience for upward adjustments, especially during periods of macroeconomic duress. Governments in LAC held prices of public services down with the intention of dampening the effects of the economic crisis. However, the results of this misguided policy were mainly to hurt the prospects of economic recovery and sustained growth by promoting the wrong allocation
of resources and fueling inflation by increasing government contributions to support the sector and to make the service more expensive and less reliable.

32. A regional survey of the road agencies has shown that only 3 of the 16 countries with reliable expenditure data had sufficient funds to maintain their networks in good condition (Box 6). Many public utilities in LAC, have developed an unhealthy dependency on the central allocation of funds. This dependency increases the power of central agencies but has made financial planning at the local level more erratic and, therefore, unreliable; moreover by reducing accountability, any attempts at the utility level to improve operations and maintenance are undermined. In the case of roads, practically all agencies depend on governments' central budgetary allocations for maintenance. Pressures on the utilities to control costs are often perceived as orders to reduce budget allocations. The first casualty is almost always maintenance. The same fate is suffered by the road agencies, except that in their case the maintenance budget is reduced at source by the ministry of finance. This process goes on for years until the consequences become evident. Then, the often seen reaction is to increase grant financing of capital spending to compensate for this neglect, and the cycle is repeated.

33. O&M budgets are often easy to slash because both the public and agency managers fail to see infrastructure deterioration until the damage has been done. Agency officials, who know that breakdown repair or reconstruction is ultimately more costly than preventive maintenance, are often forced to defer maintenance because of competing priorities. Budget reductions in maintenance expenditures are almost always a misguided and costly decision. Maintenance expenditures represent a small percentage [under 15 percent] of the total life-cycle cost of a facility; however, they have a substantial impact on the useful life and productivity of the asset in question.

34. The low expenditures on maintenance for roads is not a result of inadequate cost recovery in the road sector. A review of the road-user charge receipts of a representative sample of LAC countries indicates that all collect sufficient funds to cover at least the rehabilitation, maintenance and administrative needs of their road networks (Box 7). For example, in Jamaica the Government spent about US$40 million on roads, of which about US$12
million for maintenance, compared to average annual road-user charge receipts of about US$220 million during the period 1985-89. In Brazil total road-user charge receipts for the whole country are about US$15 billion with the contribution to the federal government alone amounting to about US$2.5 billion compared with average annual expenditures on the federal network in the period 1985-1989 of about US$1.3 billion, of which only US$396 million for maintenance and rehabilitation activities. These large differences between road-user charge receipts and road funding occur because: (a) governments find road-user taxes to be one of the most dependable sources of revenue for the treasury; and (b) the user-charge receipts are not earmarked for roads, so the sector has to compete for scarce treasury resources with all the other needs of the economy.

35. Infrastructure agency managers often blame the poor finances of their agencies on external factors over which claim little control. The poor financial condition of the agency in turn is given as the excuse for maintenance neglect. Although there is some truth to these perception; poor financial situation alone does not provide sufficient explanation for poor maintenance performance. In the utilities, the lack of liquidity—a testimony to inadequate cash generation and poor financial management—is accentuated by losses that often exceed half the volume of total production as well as by the high number of illegal connections. For roads, available funds are not used effectively. Moreover, maintenance, in all cases, is not allocated its fair share of funds. The misallocation of resources on low priority investment programs, combined with the amount of revenues foregone by inadequate practices or losses in higher operating costs in absolute terms can be larger than the funds requested. Fortunately, the solution to all these problems is well within the mandate of the infrastructure agencies.

36. Most agencies of the water/sanitation and power agencies in the region face major investment requirements in the 1990s (Box 8). To meet this challenge, these sectors need to mobilize resources and manage demand through adequate pricing of these services. Appropriate cost recovery policies are vital to ensure the long-term financial health of these utilities.
III. AN AGENDA FOR IMPROVING MAINTENANCE

37. Good maintenance requires a persistent effort and a consistent flow of funds. It also needs a strong commitment on the part of the agencies to provide excellent service. The public and relevant government officials also must be kept informed about costs and benefits to obtain their support for adequately funded maintenance programs. There are biases against maintenance that will have to be overcome. Policy and decision makers in the sector and in lending institutions must be convinced that maintenance is, indeed, an area worthy of priority attention, and that efforts to improve it most often represent the best use of scarce resources.

38. The problems leading to maintenance neglect are multifaceted. Moreover, although the different agencies and countries share most of the problems, the gravity of any particular element may vary widely depending on the sector and country. Some of the problems, especially the technical, operational, and, to some extent, the institutional ones are within the capacity of the agencies to mitigate or resolve. Others will require strong support from the public and government officials outside the infrastructure sector such as the financial problems. An overall strategy to improve crumbling infrastructure, in addition to more funds, should focus attention on: (a) improving operational efficiency; (b) developing well-costed pluriannual O&M plans and programs; (c) developing staff quality and proficiency in both managerial and technical skills; (d) ensuring the availability of a sustained and timely source of funds for O&M activities; and (e) improving accountability.

**Improving Operational Efficiency**

39. The single most effective action to improve infrastructure maintenance in LAC would be to increase management and operational efficiency; and to this end, broad private sector involvement in O&M should be promoted in most LAC countries. Such involvement could range from total or partial private ownership, under the regulation of a state commission, (the ideal case), to contracting out as much of O&M activities as possible to the private sector, with the utility retaining a core of high quality staff for strategic planning, programming O&M activities, managing contracts, and ensuring the application of adequate tariffs for appropriate cost recovery. There is scope for private sector participation in almost all LAC countries and in all infrastructure sectors. The positive experience in many industrialized countries notably the United States, France and Spain, with private sector participation in financing the provision, operation and maintenance of power, water and sewerage, and road infrastructure, can eventually be emulated in most LAC countries. To attract the financial participation of the private sector towards utilities, however, a
minimum level of performance is required by the agencies and a minimum set of conditions will have to be fulfilled by the country. At the agency level, such a threshold might paradoxically require that an adequate tariff level be in place and that the utility generate and collect enough funds to cover its costs. At the country level, a fair regulatory system, a bona fide process of settling differences, including arbitration in a neutral country, and a mechanism that facilitates access to foreign exchange is also needed. Fulfillment of the above conditions points to a long term process of steady improvement on the part of the utilities. Brazil, Argentina and Chile have embarked on such private ownership of some utilities, but the processes are still very embryonic and no conclusions can be drawn yet.

40. The same prescriptions are applicable to the road subsector, where the private sector could finance the construction, rehabilitation and maintenance of toll roads. The difference is that no threshold performance standards are expected as precondition from the agencies, since the private sector operates, maintains and sets and collects a toll after its contribution. At the country level, however, the same assurances are needed on fair regulation, access to foreign exchange, and protection from nationalization during the period of ownership.

41. Of more promise in the short to medium term is private sector participation in providing O&M services on contract. The experience in countries such as Spain, the US, Great Britain, New Zealand and in the LAC region (notably Chile (Box 9) for water and Brazil for roads) has clearly demonstrated that the private sector can provide many O&M services more cost effectively than public utilities or road agencies. Other benefits from using private contractors include: (a) supplementing utility or agency capacity to accommodate staff reductions either mandated or through emigration; (b) providing higher work quality; (c) increasing the prospects of higher maintenance funding through pressure from contractors who then become an interest group; and (d) reducing the diversion of funds.

42. In the roads subsector, more than two decades of technical assistance and institutional strengthening to improve force account productivity has proved largely futile. A study on the use of private contractors in road maintenance
carried out by the Banks's Latin America Region Technical Department, Infrastructure and Energy Division (Annex 4) concluded that there is scope for the use of contractor participation in maintenance activities in some form in almost all LAC countries. There has been success with different types of contracts including: (a) the traditional equipment-intensive contractors in Argentina, Brazil, Chile and Colombia; (b) the "micro empresa", 11 to 14 persons per contracting entity using mostly hand tools, in Colombia; and (c) the lengthman system, with one person in charge of 3 to 5 km of roads in Costa Rica and Jamaica.

43. Box 10 highlights several activities of a power or water utility that are amenable to private sector participation. In fact, it is quite common for collection to be carried out through private sector banks. Provided these activities are contracted through competitive bidding, they should be beneficial to the utility. A service contract can, of course, include one or more of the tasks mentioned. Except in the smallest LAC countries, it is unlikely that the local private sector would not have the necessary competence and the tools (hardware and software) for the job. It might also be that in these cases the magnitude of the task, and therefore the rewards, are too small to interest an international company. It is also very clear that the key activity of disconnecting those clients that do not pay in time (especially the administration) cannot easily be transferred to the contractor. The social and political price of disconnecting non-payers is normally not commensurate with the expected profit, although this is the key to reducing accounts receivable. In the case of roads, experience in LAC has shown that all maintenance activities, including emergency repair works, can be successfully contracted in most countries. The exceptions include countries with underdeveloped construction industries or remote areas of countries where work might be insufficient or too scattered to attract contractors at a reasonable price. The scope of contracts has ranged between the Brazilian case, where all maintenance activities for a given road section are contracted out as a single contract, to the Chilean approach of specialization for routine maintenance, where one or a group of road maintenance activities in a given geographic area are given out as a single contract.

<table>
<thead>
<tr>
<th>Box 10: Areas for Cost-effective Private Sector Participation in Power and Water Sector's O&amp;M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter reading and billing</td>
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<tr>
<td>Meter installation and maintenance</td>
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<tr>
<td>Collection of service payments</td>
</tr>
<tr>
<td>Transport services and maintenance</td>
</tr>
<tr>
<td>Maintenance and repair of power distribution grids</td>
</tr>
<tr>
<td>Maintenance and repair of water and sewerage networks</td>
</tr>
<tr>
<td>Maintenance and repair of house connections</td>
</tr>
<tr>
<td>Data processing centers</td>
</tr>
<tr>
<td>Water and wastewater treatment plants</td>
</tr>
<tr>
<td>Pumping stations</td>
</tr>
</tbody>
</table>
Private contractors are basically guided by profit opportunities; so to achieve the desired objectives of quality and cost-effectiveness, the utility must retain very important responsibilities for planning, packaging, procuring and supervision of contract works, i.e., in contract management. The successful introduction or increase in O&M by contract would therefore require either retraining existing staff in these functions or recruiting new ones or both, or using private consultants to assist the utility or road agency in these functions, at least during the early periods. Successful O&M contracts with the private sector should span several years (usually not less than three) to elicit a good response from potential bidders and to allow and justify a reasonable investment and commitment on the part of the contractor. This requires the utility or road agency to prepare a well-costed multi-year O&M program. It is also in the interest of public utilities to provide incentives in O&M contracts with the private sector to encourage more cost effective services. On the other hand, private firms should face the real possibility of losing contracts or profitability for inadequate performance. Equivalent incentives or sanctions generally do not exist for public agencies. Prompt payment to contractors is crucial to keep them solvent and interested and to keep costs at a reasonable level, since contractors would invariably protect themselves from losses arising therefrom through higher bids or claims.

Considerable preparatory work is needed prior to the introduction of or increasing O&M by contract. First and foremost, the impact of the change requires that all affected parties, i.e., those who would eventually lose their jobs and those to be reassigned, be involved, to a reasonable extent, in reviewing and developing the actions necessary to effect the changes. Otherwise, the necessary commitment for success would be lacking. Also, the changes should be phased in slowly, which is also consistent with achieving the necessary prerequisites (para. 41). Attractive incentive schemes for severance should be made available to affected staff, including, were feasible, giving contractors incentives to engage staff assigned to O&M work for an agreed period. Lastly, where the changes have to be rapid, as was the case for routine maintenance of the federal network in Brazil, the agency or utility should seriously consider allowing the contractors to use the utilities plant and equipment and deduct the depreciation and interest charged from their unit prices. Other steps are outlined in Box 11.

Experience in both LAC and developed countries shows that reorganizing road maintenance execution to reach a ratio of 80% by contract and 20% by force account and a 50-50 ratio in O&M for the utilities could be successfully accomplished within five years in most countries. Each public utility or road agency in LAC would need to prepare a strategy, with management consultants’ assistance if necessary, on how to increase the use of private contractors in O&M activities. The Bank and other lending agencies should be willing to finance the technical assistance in ongoing or future loans and grants.
Assessing the capacity and capability of the local construction industry - both the traditional equipment-intensive contracting part as well as the labor-intensive, community-based part and deciding the rate at which it is possible to transfer works to the private sector;

(b) Assessing the agency’s internal capacity to collect needed physical data and to manage and administer contract maintenance over and above that required for its other activities; based upon this, the agency should determine its needs for staff training and consultant’s assistance;

(c) Deciding on the type, scope and duration of contracts, the procurement procedures for contracting, payment provision and procedures and the bidding documents to be used; and

(d) Training of staff to manage the contracting process and to supervise the contract execution.

Box II: Introduction of Road Maintenance by Contract

47. Independently of whether O&M activities are carried out by contract or by force account, improvements are still needed in planning and budgeting, pricing and funding, developing staff quality and accountability. The effects of the improvements in these areas are very closely interdependent. A well prepared O&M plan and program is a prerequisite for proper budget preparation and the rational allocation of funds as well as for both internal and external accountability. Proper monitoring and accountability provides an incentive for increasing productivity. Hence, although remedial action in any one of the deficiencies would provide its own benefits, the most effective strategy would be the one which simultaneously strengthens all the areas.

Improving Planning, Programming and Budgeting

48. The O&M planning, programming and budgeting process is iterative and begins with the inventory and classification of assets. It is followed by establishing quality standards of service to set the level of O&M that will be provided, which, should then be translated into quantity standards measurable in suitable units. These quantity standards are, in turn, translated into types and quantities of resource requirements, some of which are controlled by inventory management systems. Such preparatory work, including cost/benefit analysis of major expenditures, can help identify and rank preventive and routine maintenance programs and their costs as well as support O&M budget requests. Budget exercises should be complemented by the analysis of actual allocations and expenditures over at least the last five years to determine trends and patterns and to guide future exercises.
49. With the use of applicable unit costs, the total costs of providing the required levels of O&M can then be calculated and compared to available financial resources. These levels are likely to be achieved if goals and the assessment of resource needs are forward-looking, framed in 3 to 5-year plans, and complemented by specific and monitoring indicators to assess progress. Such evaluation of O&M requirements is a valuable tool to bring into focus possible issues of the utility's finances and resource mobilization efforts.

50. Few sector agencies currently have the type of reliable data needed for planning and programming O&M activities as described above. They will therefore need to assign resources to develop it. Such data for all agencies should include a physical and condition inventory of existing facilities, maintenance history, usage, as well as the unit costs of maintenance operations and new facilities. For the utilities, the information on facilities and costs should be used to develop indicators to help decide when a unit needs maintenance or should be replaced. In the roads subsector, considerable work has been done by the Bank on the design and application of information systems for road management which would be very useful for LAC's road agencies. In fact, a significant number of the agencies has started putting such a system in place.

51. The use of benefit/cost analysis to prioritize road maintenance activities and strategies has also been very highly developed by the Bank through its world-famous Highways Design and Maintenance Standards Model (HDM) and the companion Expenditure Budgeting Model (EBM), which, together permit: (a) selection of the optimal package of road activities within a given budget, or unconstrained budget if the EBM is paralysed; (b) planning and programming of the selected activities; (c) rational allocation of the road subsector resources to the most economic activities and (d) the preparation of a needs-based and economically-prioritized budget (Box 12).

**Staff Development**

52. Improving the quality of O&M staff requires the attraction, retention and motivation of qualified staff and good training. The critical issue for ensuring availability of qualified personnel for proper O&M is the civil-service constraint on salary levels paid by public utilities and road agencies. Where such constraints seriously impair hiring and retention of qualified personnel, especially higher management utilities should be allowed to exercise the flexibility they theoretically possess as autonomous financial entities to set competitive salaries, provide pecuniary incentives, and use performance evaluation procedures to improve reward systems. Road agencies should also be granted such autonomy after agreement between them and the governments on a work program, quality standards and a budget to implement the program. An
incentive for the Government to grant such autonomy would be for the utilities and agencies to agree to stay within the salary budget by laying off redundant staff, using the resulting savings to pay deserving staff more. In countries where the utilities and agencies cannot operate outside the civil service constraints, attractive benefits in the form of subsidized housing, car allowance, access to government-paid further education and sabbaticals and health programs have helped to retain staff.

53. One key option for improving staff quality wholly within the authority of the utilities and agencies is staff training at all levels. The training program itself should clearly identify staff to be trained, skills to be acquired and improved, where and when training will take place, how the training will be conducted and how its success will be measured. In the current environment, when private sector participation in O&M activities is stressed, the training of agency staff to administer and manage the contracting procedures and contract execution should be given high priority. Management commitment to release staff for needed training and to recognize their enhanced skills after training is imperative for the long-term success of any such program. The effectiveness of the training should be established against previously agreed indicators established as part of the training program. International and regionwide institutions have been successful in assisting with the organization of such training. Close cooperation between the local universities and the utility and road agencies in joint research and training programs has also proved effective in the road subsector in Chile, Uruguay, Argentina and Brazil. Lastly, cross fertilization among the agencies in LAC, both in staff training and sharing experiences and research findings, is already taking place among Chile, Panama,
Bolivia, Honduras, Colombia, Brazil and the Dominican Republic and should be strongly encouraged.

**Ensuring Adequate Pricing and Increased and Reliable Funding**

54. The financial problems of the power and water utilities are in the main different from those of the road agencies because the former charge directly for their services and keep the funds while road use, except for the minority (i.e., toll roads), is charged through taxes and charges collected by the Ministry of Finance which generally is added to general revenues. Therefore the options for the utilities are quite different from the road agencies.

55. The governments, local and national, as owners of most of the utilities basically have the financial future of these enterprises in their hands. To succeed, they must place more emphasis on adequate cost recovery policies which are fundamental to their long-term financial health and their ability to provide adequate O&M. The infrastructure sector demands large investments in generation plants, water treatment plants, roads, etc., and, given the long lead times of these projects, ensuring their future availability requires the commitment of funds several years in advance. Price influence demand, and demand in turn determines the size of new investments. Insufficient pricing policies fail to send the right signals to consumers and promote a misallocation of scarce resources to new investments for capacity expansion to the detriment of O&M activities. Thus, rational pricing policies are vital to achieving reliable maintenance funding. Box 13 presents some of the benefits associated with sound pricing in the power and water sectors. In the use of the funds generated through the above efforts, priority should be given to O&M to help reduce electricity and water losses, cut down operating costs and prolong the life of equipment and facilities thereby saving more money. These saving would, in general, more than offset the O&M costs needed to generate them. The utilities, in the allocation of resources, should also use life-cycle benefit/cost analysis which would result in the most economically beneficial activities receiving appropriate priority. Contractors response to O&M activities has been poor.

56. For the road agencies, for which O&M activities are funded from the central budget, experience in LAC and elsewhere has shown conclusively that maintenance is chronically underfunded although maintenance and rehabilitation activities have much higher ex-post economic returns than other non-road sector activities and road users contribute more than sufficient funds compared to road needs. Since the road maintenance neglect has reached crisis proportions in LAC, with an estimated US$1.7 billion a year being wasted on higher vehicle operating costs and premature reconstruction, it is recommended that, as a 'second best' solution to central allocation of funds, a portion of road-user
There are several economic and sector benefits of sound electricity and water pricing policy, among which the most important are:

- Price is the best inducement for conservation. Industries will invest in conservation to the point where the cost of saving an additional unit of energy (or water) is the same as the purchase price of that energy (or water).
- The benefits for the country of subsidizing energy (or water) consumers are less than the benefits of allocating the equivalent subsidy to infrastructure, social, and human capital formation.
- Proper prices lead to better financial situations for the sector utilities which in turn lead to maintenance expenditures and replacement investments to improve operating conditions and the quality of supply (i.e., reduce costs, improve availability and reliability of supply).
- Adequate prices are necessary to implement efficiently and reliably a proper maintenance policy, to lower forced outage rates, raise efficiency and availability factors, lower losses and improve reliability of supply.
- Sound pricing also encourages efficiency in supply by providing utilities market signals for an efficient operation and investment program.
- Sound pricing improves the chances for private sector participation.

Box 13: Benefits of Sound Economic Pricing

charges be earmarked to cover the total needs for removing the maintenance backlog and preventing its further recurrence and for managing the networks including vehicle weight and dimension control and improvements in traffic safety. It is fully recognized that earmarking introduces distortions compared with central allocation of resources, however, the magnitude of such distortions would be less than the losses being incurred from maintenance underfunding.

57. The earmarked funds should be established by law to ensure permanency and some minimum protection. Also, to ensure that the proceeds from the funds remain adequate, mechanisms should be incorporated to reflect cost escalation, traffic growth and network expansion. The funds should be paid directly into a trust fund managed by the ministry responsible for the road network. A Monitoring Committee, comprising representatives from interested ministries, user groups and the road construction industry, should be established to monitor the use of funds and the road agency’s performance against the agreed program. Funding for road improvement and new construction, under this arrangement, should not be from the earmarked funds but should continue to come from the general budgetary allocations. Such a separation would help to prevent a recurrence of the bad experience in some LAC countries where single earmarked funds for both maintenance and major works led to practically all funds going for construction, sometimes of roads of questionable economic justification.

58. The form of earmarking described above would buttress the institutional reforms recommended earlier, i.e., the move towards the increased
use of the private contractors for O&M activities. With earmarked funds and an agreed program to implement, the maintenance organization itself would be operating as a contractor on a cost-plus or negotiated contract. In time, private contractors would be brought in to compete with the agency on competitive bidding. Experience has shown (for example on the federal network in Brazil) that when such a reliable source of funding is assured, the private sector is more than willing to compete fiercely for maintenance contracts. As a corollary, in those cases in which timely funding has not been forthcoming, maintenance by contract has not proved successful in the long-term.

59. Considerable support from the general public and interested groups--such as truckers and automobile associations, contractors associations, and from the high officials of the ministries of agriculture, industry, health, planning and of finance--would be necessary to assure the passage of the road earmarking legislation or increasing the levels of budgetary allocations. For such support, the road agencies need to educate these groups about the condition of the road infrastructure, the costs of maintenance neglect to the economy and the effects on vehicle operating costs and transport costs to the public. Dissemination of such information can be done through education/publicity campaigns, seminars for interest groups and well-prepared, illustrated presentations for top officials of the ministries of finance, planning, industry and agriculture. In exchange for such support the road agencies must deliver on the maintenance services to establish their credibility. Box 14 presents a recommended procedure for earmarked funds.

60. **Improving Accountability.** The delegation of responsibilities to power and water/sanitation sector agencies should be followed by delegation of the necessary authority to recover costs and mobilize resources to sustain O&M. Only then can accountability be squarely placed on the operational level. The sense of responsibility and accountability for operations and maintenance is greatest when the organizational structure responds in a rational way to current problems and when the staff is given clear and distinct tasks in line with their skills, experience and interest as well as the means to discharge their functions efficiently. To improve the efficiency and effectiveness of the O&M functions, suitable types of activities should be clearly vested in accountability centers that function as internal service units with the organization. Examples of these centers are: meter repair shops, vehicle workshops, water treatment facilities and inventory stores. These centers should be given clear goals and indicators to monitor performance and some flexibility in their operations to provide area managers with the necessary incentives for efficiency.

61. Different approaches are currently being tried in the LAC countries to remove the managerial and institutional barriers. In Chile, the policy includes the decentralization or segmentation of the power sector into smaller units
concerned with only one component of the electric system: generation, transmission or distribution. It also includes the independence of the utilities from government intervention and the application of efficient tariffs related to marginal costs at generation, transmission, and distribution levels. In Colombia and Venezuela, major restructuring efforts are underway to induce competition and private sector participation in generation and distribution. Performance contracts are being examined in Bolivia and Panama. The goal of the contracts is to raise overall efficiency by providing the utilities more management freedom and corporate independence. A performance contract is signed between the government and the public utility, where pecuniary incentives are established if the utility achieves the agreed goals. Agreements are formalized to give the utility flexibility and autonomy in acquiring goods, contracting services and managing its salary levels to carry out the performance contract. The Bank's experience with these contracts so far indicates, however, that they are effective only as a temporary measure. With time, the contractual parties relax on enforcement and the situation reverts to its original state.

62. Because LAC road agencies depend on public funds for their O&M activities, accountability, both internally within the road agencies and externally vis à vis the government and the general public assumes an even higher importance. To improve internal accountability, the existing annual financial performance audits should be extended to include the degree of attainment of previously agreed performance monitoring indicators. A selected list of such indicators for water and sanitation is given in Box 15. For this to be feasible, a clear definition is needed of the standards to be achieved by the maintenance organizations and the resources required to achieve them. It is advisable that the list be restricted to the most important indicators. For example, in the utilities, the financial rate of return and a standard of quality would be the two key considerations.

Key Considerations

1. Prepare need-based, costed, multiannual road rehabilitation maintenance program;

2. Review alternative sources for financing the program with respect to adequacy of funds, consistency, reliability and timeliness of flow;

3. Determine (a) levels of required earmarking in addition to other sources that pass the criteria under (2); (b) items of user-charges to be earmarked; and (c) the mechanism to channel earmarked funds to the road agency;

4. Establish and provide terms of reference for a Monitoring Committee comprising representatives from interested ministries and user-representatives to monitor the use of funds and the road agency's performance against the agreed program; and

5. Establish the earmarking mechanism and the Monitoring Committee by law;

6. At all stages, involve the principal actors: finance, planning, agriculture, industry, road agency's top management, and road users.

Box 14: Earmarking Funds for Road Rehabilitation & Maintenance
key indicators to monitor. An internal review of physical performance targets and available funds, at least semi-annually, is also strongly recommended. External accountability can be increased through (a) the establishment of independent national commissions, with both public and private sector representation to monitor the road agencies' performance annually; (b) the publication by the road agencies of annual reports indicating needs, the resources made available and performance; and (c) the organization of annual seminars to discuss the above report with interest groups such as transport unions, road consultants and contractor associations. An important and beneficial byproduct of these actions would be increased political support from interest groups for the agencies' road maintenance programs and budget proposals. Care should be taken to avoid undue influence of these groups on the road agencies' plan.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Unit</th>
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<tbody>
<tr>
<td><strong>General</strong></td>
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<tr>
<td>Personnel</td>
<td>staff per 1000(w+s) conn.</td>
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<tr>
<td>O&amp;M costs</td>
<td>Staff cost per operating unit</td>
</tr>
<tr>
<td></td>
<td>$ per m3 produced</td>
</tr>
<tr>
<td></td>
<td>$ per cost center</td>
</tr>
<tr>
<td></td>
<td>$ per yr per $ of assets</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td></td>
</tr>
<tr>
<td>Quality</td>
<td>WHO guidelines</td>
</tr>
<tr>
<td>Chemicals</td>
<td>dosage per m3 produced</td>
</tr>
<tr>
<td></td>
<td>$ per m3 produced</td>
</tr>
<tr>
<td>UFW and leaks</td>
<td>% of production</td>
</tr>
<tr>
<td></td>
<td>liters per day per km.</td>
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<tr>
<td></td>
<td>liters per day per km.</td>
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<tr>
<td>Breaks</td>
<td>% per km per year</td>
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<tr>
<td></td>
<td># per km pipe material.</td>
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<tr>
<td>Metering</td>
<td>% total connections</td>
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<tr>
<td></td>
<td>% working meters</td>
</tr>
<tr>
<td>Energy use</td>
<td>kwh per m3 produced</td>
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<tr>
<td></td>
<td>$ per kwh</td>
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<tr>
<td><strong>Sewerage</strong></td>
<td></td>
</tr>
<tr>
<td>Infiltration</td>
<td>m3 per diam-length per day</td>
</tr>
<tr>
<td>Blockages</td>
<td>% per km per year</td>
</tr>
<tr>
<td>Breaks</td>
<td>% per km per year</td>
</tr>
<tr>
<td>Complaints</td>
<td>% per 1000 conn per yr</td>
</tr>
<tr>
<td></td>
<td>response time per days</td>
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Box 15: Selected Monitoring Indicators of O&M for Water/Sanitation Sector
IV. THE ROLE OF THE BANK AND OTHER LENDING AGENCIES

63. In addition to providing funding, the lending agencies have three main roles to play beyond their own financial contributions in helping to improve maintenance: (a) assist in making the responsible authorities in the LAC countries (top officials of the ministries of finance and planning) of the magnitude and critical nature of the infrastructure maintenance problem in their countries; (b) accelerate adequate cost recovery and funding for maintenance activities; (c) assist the agencies to use the available funds efficiently which implies, for most countries, more private sector involvement and assistance to (i) define policies governing private sector participation, (ii) strengthen the regulatory system to ensure fair pricing, and (iii) build the supervisory capacity to manage O&M activities carried out by contract. A tripartite collaboration among the donor community, the government and the utility and road agencies would be the most promising formula for success.

Donor Role in Disseminating Information About Infrastructure Maintenance

64. The Bank, with other multilateral agencies, has organized several regional maintenance conferences since the early eighties to promote discussions among the representatives of the individual infrastructure agencies and to share common experiences and solutions. These conferences have mostly been attended by agency technical and management staff, even when pains have been taken to encourage the participation of finance and planning ministry staff. The result is that the financial question is discussed by delegates who have little power to effect any changes. To give the financial problem the focus it deserves, a series of seminars should be convened by the Bank (by LATIE and EDI) for top officials of finance, planning and infrastructure sector ministries in the LAC countries to discuss the critical nature of the maintenance problem and the financial implications for its solution. The presence of top sector staff would be useful to explain the technical points where necessary.

Donor Role in Facilitating Adequate Funding

65. International lending and donor agencies should work together with the LAC countries to provide appropriate support for the removal of long-standing maintenance problems and to give maintenance its deserving priority. The lending agencies should agree to lend for contractor executed maintenance, especially during the period of transition from force account. The agencies should also work with the Governments to establish appropriate cost recovery and more reliable mechanisms for financing maintenance activities. The Bank itself could assist in ensuring a fair share of public sector expenditures on
rehabilitation and maintenance through its public sector expenditure reviews in the Borrowing countries.

**Donor Role in Improving Maintenance Management and Execution**

66. The lending agencies should assist the Governments to increase the use of private contractors for maintenance in the countries where conditions permit their usage. To this end, they should assist: (a) the governments to develop a policy for private sector involvement; and (b) each national infrastructure agency thereafter to develop a reasonable strategy on achieving this. The lending agencies should be prepared to finance any necessary technical assistance to develop such strategies under ongoing loans or grants.

67. The lending agencies, notably the Bank and the IDB, should assist the infrastructure agencies in putting in place maintenance management systems (MMS) and more rigorous cost/benefit analysis of investments and maintenance options. The lending agencies should also support governments more actively in their efforts to improve accountability of institutions and public officials as well as a more transparent decision-making process with broader public participation.