A VIEW OF ROAD MAINTENANCE ECONOMICS AND POLICY IN THE THIRD WORLD

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IRF EXECUTIVE CONFERENCE ON THE MANAGEMENT OF ROAD MAINTENANCE, ARIZONA
11-27 FEBRUARY 1987

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1 INTRODUCTION

Purpose of maintenance
Maintenance reduces the rate of road deterioration, it lowers the cost of operating vehicles on the road by providing a smooth running surface, and it keeps the road open on a continuous basis by preventing it from becoming impassable (World Bank 1981).

It is convenient to group maintenance activities according to the frequency of operation, as used in Overseas Road Note 1 (TRRL Overseas Unit 1981).

(i) Routine: required whatever the engineering characteristics of the road or the density of traffic it carries; may therefore be considered as 'fixed-cost' activities.

(ii) Recurrent: required at intervals throughout the year, but whose frequency varies with traffic.

(iii) Periodic: required only at intervals of several years.

(iv) Urgent: in practice the need will sometimes arise for certain maintenance activities to be carried out on an urgent basis when a road is cut; this fourth classification is therefore included for work such as the removal of debris, the erection of warning signs or construction of diversions, which must be carried out with minimum of delay to avoid danger to traffic.

Upgrading and rehabilitation
Upgrading aims, specifically at providing additional capacity when a road is nearing the end of its design life or because there has been an unforeseen change in the use of the road. Typical examples of upgrading projects are the paving of gravel roads, the provision of strengthening overlays for paved roads and the widening of roads. Upgrading projects should not be confused with maintenance, and it is important that feasibility studies for upgrading projects should base future predictions of road condition on a realistic assessment of existing maintenance capability (Robinson 1984).

Rehabilitation is needed either because a road has outlived its design life or, more usually, because the road has received insufficient maintenance to enable it to provide an appropriate level of service to the end of its design life. Additionally, rehabilitation may be needed because the original road was not built to the standards of quality required by the original design. As for upgrading projects, the feasibility of rehabilitation should be based on a proper assessment of the effect of maintenance on future road condition.
2. ECONOMICS OF MAINTENANCE

Reducing road deterioration

Even with proper maintenance, roads will deteriorate with time and the rate of this will depend on a number of factors including traffic loading, road strength and climate. Eventually there comes a time when the end of the design life is reached and there is a need for strengthening or reconstruction. As shown in Table 1, these are very high cost activities and should therefore be postponed for as long as possible by carrying out effective and timely maintenance.

<table>
<thead>
<tr>
<th></th>
<th>Paved</th>
<th>Unpaved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine maintenance</td>
<td>500</td>
<td>1,000</td>
</tr>
<tr>
<td>Periodic reseal (5 years)</td>
<td>12,000</td>
<td></td>
</tr>
<tr>
<td>Overlay (10 years)</td>
<td>42,000</td>
<td></td>
</tr>
<tr>
<td>Regravelling (5 years)</td>
<td>175,000</td>
<td>8,000</td>
</tr>
<tr>
<td>Reconstruction</td>
<td></td>
<td>45,000</td>
</tr>
<tr>
<td>Annual Maintenance cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(apportioned over 10 years)</td>
<td>6,000</td>
<td>2,500</td>
</tr>
<tr>
<td>New construction</td>
<td>250,000</td>
<td>120,000</td>
</tr>
</tbody>
</table>

(source: Faiz and Harral 1987)

If proper routine and recurrent maintenance are not carried out, drains will not be cleared and surface defects not repaired, both of which will result in water penetrating the structure of the road. For paved roads, the resulting road distress will require that periodic maintenance is needed prematurely which is ten times more costly than routine and recurrent maintenance. Failure to carry out periodic maintenance at the appropriate time soon leads to the need to carry out road strengthening which is three times more costly than periodic maintenance. If this strengthening is not carried out soon enough, major deterioration sets in and rehabilitation will be required which is up to fifteen times more costly than periodic maintenance. Clearly, there is considerable economic benefit in
carrying out appropriate maintenance at the right time as deferring maintenance works results in a rapid escalation of costs. This will be even more apparent in areas subject to very high rainfall.

A further problem is that maintenance funds are often diverted and spent instead on new construction. The consequences of this can be illustrated by reference to the following example. Assume a national road network of 1,000 km of paved road and 1,000 km of unpaved roads. Based on Table 1, this network will require an annual maintenance expenditure of:

<table>
<thead>
<tr>
<th></th>
<th>Paved roads:</th>
<th>Unpaved roads:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$6.0 million</td>
<td>$2.5 million</td>
</tr>
</tbody>
</table>

This network therefore requires an annual budget of $8.5 million to cover maintenance expenditure alone. If this budget is also used to extend the network by 1 per cent each year, the following will result.

<table>
<thead>
<tr>
<th></th>
<th>Paved</th>
<th>Unpaved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual increase in road length</td>
<td>10 km</td>
<td>10 km</td>
</tr>
<tr>
<td>Annual construction cost</td>
<td>$2.5 million</td>
<td>$1.2 million</td>
</tr>
<tr>
<td>Balance of budget remaining</td>
<td>$3.5 million</td>
<td>$1.3 million</td>
</tr>
<tr>
<td>Length of road that can be maintained each year for this sum</td>
<td>583 km</td>
<td>520 km</td>
</tr>
</tbody>
</table>

If this budgetary policy continues for 10 years, 100 km of new paved road and 100 km of new unpaved road will have been provided, but lack of maintenance over this period will have resulted in the following length of network becoming unserviceable.
Table 3

<table>
<thead>
<tr>
<th></th>
<th>Paved</th>
<th>Unpaved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss to road network over 10 year period</td>
<td>417 km</td>
<td>480 km</td>
</tr>
<tr>
<td>Cost of rehabilitation of unserviceable network</td>
<td>$73.0 million</td>
<td>$21.6 million</td>
</tr>
</tbody>
</table>

Thus, over a 10 year period, the result of adding 200 km of new road has resulted in the loss of nearly 900 km of existing road through lack of maintenance. This is assuming that remaining maintenance funds are concentrated on a restricted network. If the remaining funds were instead spread more thinly over the entire network, the loss of serviceable roads over a 10 year period is likely to be even greater. The analysis in this example takes no account of the additional maintenance requirement for the new roads which imposes an additional burden of $600,000 and $250,000 per year for paved and unpaved roads respectively.

Lowering vehicle operating costs

Cost savings obtained by deferring the need for rehabilitation do not include savings in the wear and tear on vehicles caused by the resulting bad road surfaces. Over the life of a road, vehicle operating costs are typically four times the size of initial construction cost, whereas maintenance is only one or two per cent of the total road transport cost. If maintenance is neglected, a paved road will crack and pot-holes will start to appear. With this level of deterioration, vehicle operating costs are likely to increase by about 15 per cent. If there is further neglect of maintenance, a paved road will eventually start to disintegrate and vehicle operating costs will increase by about 50 per cent. This is approximately twice the cost of constructing the road initially. This massive increase in transport cost is many times the cost of road rehabilitation and results from failure to make a relatively small investment in road maintenance.

As an example, TRRL investigated a 100 kilometre length of road in one country carrying about 750 vehicles per day. The road had been opened for about four years but, during that time, had received no maintenance. The road was already cracked and deformed, and pot-holes were starting to appear. This deteriorating road condition was already leading to an extra vehicle operating cost estimated to be about $1.5 million per year. A further estimate suggested that, if this
situation was allowed to continue, the road would soon start to disintegrate and, in this case, the additional vehicle operating costs were estimated to increase to about $5.0 million per year (Robinson and Roberts 1982). This additional cost would be spent on additional fuel, tyres, spare parts and vehicle replacements, all of which are foreign exchange items in most developing countries. Road maintenance, with its relatively high local cost component, can therefore be viewed as a mechanism of import substitution.

Keeping the road open
The third reason for carrying out maintenance is to keep the road open on a continuous basis. Roads serve centres of population and industry and, if roads are closed by landslides, culvert washouts, or by the surface becoming impassable during the wet season, then there are serious social and economic consequences.

A case has been noted where, in one country during the wet season, 40 per cent of vehicles failed to reach their destinations because of the state of the roads. This resulted in factories having to close for several months because of the failure to get raw materials in and to get manufactured goods out. Agriculture suffered in a similar way because of lack of fertilisers and the failure to sell produce. If industry and agricultural goods are being produced for export, this has further serious implications for foreign exchange earnings.

Investments in roads
Improvement in road maintenance which reduce vehicle operating costs by between 15 and 50 per cent for the same traffic level, have led to internal rates of return on donor-financed maintenance projects which are generally above 100 per cent. Few maintenance projects have had rates of return as low as 50 per cent, whilst the return on new construction projects rarely exceeds this figure. Feeder road construction projects generally have even lower returns. The high rates of return achieved in maintenance and rehabilitation projects confirms that many roads are in poor condition.

The fact that rehabilitation shows returns which are normally higher than those for new construction corroborates the belief that the roads were initially built using rational selection criteria: projects whose returns were marginal in the past have gradually become justified with economic growth that has resulted in increased traffic. However, the return on these projects is still lower than those being achieved now on those projects that were actually implemented earlier. Thus, existing roads will normally be more important economically than new ones.
otherwise they would not have been built first. Thus, the maintenance of existing roads should normally have the first call on resources before the building of new roads. Additionally, once construction costs have been sunk in an existing road, the returns on carrying out maintenance will be very large if this prevents the benefits associated with the road being lost. Even so, it still may not be economic to maintain some low traffic roads in good condition. A balance must be struck between maintenance expenditures and reductions in vehicle operating costs and, at low traffic levels, the required maintenance expenditures will often outweigh the vehicle operating cost saving derived from the provision of a higher level of service.

Investments in transport are among the highest yield investments available. This suggests that, if funds are reallocated from other sectors, this should result in an overall increase in benefits to countries' economies as a whole. Normally, projects with the highest benefit should be undertaken first, followed by successively lower benefit projects until funds are exhausted or the benefits of additional projects are below the opportunity cost. However, there are difficulties in comparing the benefits of different types of projects from different sectors. For road maintenance projects, with expected rates of return in excess of 100 per cent, even if there is a large shortfall in anticipated benefits, the resulting project is still likely to have a higher rate of return than other transport projects or projects from other sectors.

It is clear from an economic point of view that there is an overwhelming case for carrying out effective and timely road maintenance and that substantially more resources should be devoted to this area.

3 ROAD NETWORKS

Developing countries (Faiz and Harral 1987) have a total road network of approximately 1.8 million kilometres of engineered primary and secondary roads of which just over one million kilometres are paved. They have an estimated replacement cost of $300 billion, excluding the cost of land, major earthworks and bridges. In addition, there is a network of low-volume unpaved tertiary roads and tracks comprising some 5 to 6 million kilometres but, because of their lower standards, these have an estimated replacement value of only $75 to $100 billion.

Surveys that have been carried out, principally by the World Bank (Mason et al 1984, Mason 1985, Faiz and Harral 1987), suggest that, of the paved roads in
developing countries, only just over 30 per cent are in good condition and more than 25 per cent are in poor condition, requiring rehabilitation. The figures for unpaved primary and secondary roads are even worse, with fewer than 30 per cent being considered to be in good condition and nearly 35 per cent requiring rehabilitation. No figures are available for minor unpaved roads and tracks. Comparative figures for the United Kingdom trunk roads suggest that 85 per cent are in good condition and only 3 per cent require rehabilitation.

The surveys in developing countries also indicated that there was a backlog of about $41 billion for rehabilitation and that about $4.6 billion a year extra needs spending over the new five years to prevent those parts of the network currently in good or fair condition from deteriorating further. With such backlog, it is not surprising that the situation is deteriorating. It is difficult to obtain good data to illustrate this because, in most countries, road condition is not monitored on a continuing basis. However, data have been obtained from two countries.

In the first of these countries, detailed measurements of road roughness carried out by TRRL over the period 1978 to 1982 showed that there were increases ranging from 5 to 17 per cent, depending on the type of pavement construction. In a second country, over the same five year period, paved roads deteriorated from a serviceability index of 3.6 to 3.0 on a scale of 5 (good) to zero (bad). Unpaved roads deteriorated from an index of 3.2 to 1.9 over the same period. The road maintenance organisations in both these countries are fairly efficient and the rate of deterioration is therefore likely to be faster in many other places.

4 REASONS FOR THE DECLINE IN ROAD CONDITIONS

The road maintenance problem has arisen because of a combination of factors (World Bank 1981) and it is convenient to group these under three headings.

**Network and traffic**

There have been large increases in the lengths of road networks in developing countries in the last 20 years which have directly increased the road maintenance burden. Roads built at the beginning of the post-colonial period tended to be designed for a 20 year life, whereas, because of financial constraints, roads built more recently have been designed for only 10 years.
This has resulted in many roads coming to the ends of their design life at the same time, increasing the need for reconstruction. Traffic growth over this period has been very rapid, and deterioration has been accelerated because of the large numbers of overloaded vehicles.

**Funding**

In the past, available funds have often been spent on less economic investments both in the road sub-sector and elsewhere. In addition, funds allocated to maintenance have often subsequently been diverted to non-maintenance projects. As a result, local funds are now short and foreign exchange is virtually unobtainable in many countries. A further problem is that funding is often irregular which makes planning difficult and uncertain.

**Efficiency**

There is much evidence to suggest that, even if funding levels were increased dramatically, the level of maintenance that could be carried out would still be limited because of inefficiencies in maintenance organisations. Most organisations have large labour forces which are unproductive because of poor management, lack of training, lack of incentives and lack of resources to carry out maintenance. This has been compounded because of the failure to establish priorities both by governments and maintenance authorities. There seem to be cultural difficulties resulting in a lack of discipline and the wish to do a good job, and this is not helped by absent or ineffective supervision. Poor attitudes to maintenance are sometimes shown by politicians, planners and engineers who often prefer to be associated with glamorous construction projects rather than the day-to-day problems of maintenance. The same view can also be seen among donors. In many developing countries, there are still shortages of skilled personnel despite considerable past efforts with technical assistance and training. Maintenance is normally carried out by the public sector which, because of lower salaries and lack of ability to pay incentives, often find it difficult to attract and retain high quality staff. There are also frequent changes in staff because of political and administrative changes. Equipment availabilities have been found to be generally very low, with the result that costs of using equipment are unnecessarily high. All of these aspects combine together to result in low output.
5. THE PARIS CONSENSUS

Concern over the road maintenance problem led the World Bank to call a meeting in Paris in February 1980 to exchange views on the difficulties faced by developing countries and development aid agencies in the field of road maintenance, and to seek consensus, wherever appropriate, on ways to overcome these difficulties. The meeting was attended by representatives of most of the major aid donors and the following eight-point action plan was considered (World Bank 1981).

(i) Periodic maintenance would be eligible for aid funding in the case of the poorest countries;
(ii) Routine maintenance should be eligible for funding under certain circumstances and in the poorest countries;
(iii) Spare parts were seen as essential and should be funded, with encouragement for the countries concerned to build up their own capacity to finance spares through such mechanisms as plant hire schemes;
(iv) Equipment should be delivered under and operated under aid projects in such a way as to minimise the burden of replacement and with the object of developing countries financing replacement from their own resources;
(v) Training was to be given priority, preferably under grants;
(vi) Reconstruction of roads would favour situations where reasonable preventative maintenance had been done;
(vii) Maintenance and maintenance capability would be reviewed in connection with any new construction project, and aid agencies would coordinate their efforts to encourage better maintenance throughout the entire highways sub-sector; and
(viii) Private contractors were to be encouraged to develop by employing them under proper supervision on a range of road maintenance tasks, with experiments to determine the best procedures in each country. Aid agencies were to develop means of assisting contractor development through highway authorities or development banks or both.

6. PROGRESS SINCE PARIS

The Paris initiative was timely and the concerns being expressed by several developing countries and aid donors about the poor state of road maintenance resulted in positive changes being made. Several of the bilateral and
multilateral donors attending the meeting effected changes in their lending policies to enable aid for road maintenance to be provided. However, it is difficult to escape the conclusion that those policy changes have had only a small effect on the actual aid disbursed since the Paris meeting. The majority of road subsector aid is still spent on new construction and, of the remaining amount, the vast proportion is spent on rehabilitation rather than on maintenance.

Attempts have been made to develop awareness of the problem by holding regional seminars and conferences specifically devoted to the road maintenance problem in Asia, Africa and Latin America. In addition to these regional activities, other meetings have taken place in individual countries. Both the World Bank (1981) and the IRF (undated) have prepared pamphlets aimed at senior policy makers and have produced these in several languages free of charge. Initiatives have also been taken to provide maintenance workers with manuals to assist them in their day-to-day operations. The United Nations Economic Commission for Africa with the co-operation of France, the Federal Republic of Germany and the United Kingdom, have produced a handbook for road maintenance foremen and have provided 20,000 free copies for African countries (UNECA 1982). The Transport and Road Research Laboratory have produced two manuals for District Engineers and these have also been made freely available to all developing countries (TRRL Overseas Unit 1981,1985). In addition, ESCAP (1981) have produced a maintenance manual for use in South East Asia. More recently, IRF have produced a series of video training aids aimed at improving road maintenance operations in developing countries.

However, even in those countries which have shown a determination to overcome their maintenance problems, the world recession of 1980–2 has thwarted their endeavours and this is particularly apparent in Africa (World Bank 1984). Whereas, for industrialised countries, GNP rose by 2.3 per cent in 1983 following a fall of 0.1 per cent in 1982, this recent recovery has not been reflected elsewhere, even in those countries with the best earlier records. Neither did developing countries benefit from the 1983 recovery. In these circumstances, countries find it difficult to provide the additional resources that are necessary to revitalise activity in the roads sub-sector.

In recent years, donors have experienced more difficulties with project implementation. Various reasons account for this. More projects have been
directed towards maintenance instead of new construction and are therefore more complex, requiring a greater administration effort. The limited institutional capability in recipient countries has found it particularly difficult to cope with the more complex projects. In addition, shortage of government funds has sometimes resulted in the execution of projects being stopped or sometimes being delayed in an unsystematic and costly way. Indeed, even institutions which had been well founded and had operated well in the past have started to deteriorate due to the macro-economic effect. The result is that many projects are merely slowing deterioration, rather than achieving positive improvements to networks as a whole.

The aid donors met again in 1985 in London to review progress since the Paris meeting. Whereas the theme for the Paris meeting had been the 'road maintenance problem' (World Bank 1981), delegates now found themselves discussing the 'road maintenance crisis' (Robinson et al 1985).

7. MANAGEMENT

Management systems

Although there are still some technical problems to be solved in connection with road maintenance, most problems that exist are managerial rather than technical. The problem of road maintenance is principally one of getting the right personnel, materials and equipment on to the right piece of the road to carry out the right remedial or preventative work at the right time.

Modern management systems (PTRC 1985) have been introduced in some countries to try to improve the organisation of maintenance. Unfortunately, the implementation of systems such as these into developing countries has often proved ineffective. Difficulties have arisen because of a lack of properly motivated and trained staff and because maintenance supervisors have been reluctant to tolerate the sort of cross-checking that any management system requires.

It is often thought that the computer with its associated programs is the key element in the system and, providing that this is available and running, then the management system will operate successfully. In fact, the computer is one of the least important components of a management system. It only provides a data bank and there is no reason why this should not consist of a
ledger book, a card index, or files in a cabinet. However, use of a computer does help to simplify data recording, sorting and interpretation and, particularly with the availability of cheap microcomputers, it is sensible to make use of such a powerful tool (Snaith et al 1982).

Implementation of systems

Studies carried out by TRRL (Robinson 1986) have shown that management systems can be useful tools but, if introduced, their purpose and the benefits from their use must be fully understood by the people expected to operate them. The systems must be appropriate to the country where they are being used and not just "borrowed" from other countries where maintenance problems and social conditions may be quite different. Systems cannot be introduced at zero cost or without additional staff. They should be simple and easy to use.

When introducing a system, a progressive approach should be adopted, with development over several years. This will ensure that initial efforts can be concentrated on tasks which will produce early and tangible results. Only when one stage has been set up and is working reasonably well should the next stage be attempted. Within a country, it may be best to introduce new procedures on a district-by-district basis as this enables training resources to be utilised more easily. Initially, efforts should be concentrated on the most heavily trafficked lengths of road. When maintenance on these is satisfactory, maintenance planning should be extended to the less heavily-trafficked roads.

Implementation of systems into several countries has been unsuccessful because of failure to recognise the need for and to implement the above items.

A management system has several purposes. Among these will be the following:–

(i) To provide the means of developing annual work programmes, resource requirements and budgets.
(ii) To ensure an equitable distribution of funds over the country and to enable priorities for allocations to be determined in a rational way when available funds are inadequate.
(iii) To authorise and schedule work.
(iv) To provide a system of monitoring the efficiency and effectiveness of maintenance works.
A management system achieves its objectives by providing a systematic method of operation for all staff engaged on maintenance work. Thus, a management system is principally concerned with managing the people who have the responsibility for maintaining the road network.

Steps in the management process
A maintenance system normally contains the following components:-

(i) **Inventory** This is used as the basic reference for planning and carrying out maintenance and inspections.
(ii) **Inspection** Road condition should be determined by taking physical measurements of defects on the road network in the field.
(iii) **Maintenance needs** These are determined by comparing the measurements of road condition with predetermined maintenance intervention levels that are based upon economic criteria.
(iv) **Costing** Unit costs are applied to the identified maintenance tasks to determine the budget required.
(v) **Priorities** If the budget is insufficient for all of the identified work to be carried out, it is then necessary to determine priorities to decide which work should be undertaken and which should be deferred.
(vi) **Execution** The work identified should be carried out, and several systems of scheduling and cost-accounting are available to assist with this.
(vii) **Monitoring** This serves two purposes:-
(a) it ensures that work identified has, in fact, been carried out,
(b) it provides data to enable unit cost and intervention levels to be checked and adjusted if necessary.

8. THE WAY AHEAD

Network priorities
There are several areas where steps need to be taken to help to ease the road maintenance problem.

Of the roads budgets available in developing countries, very little is normally allocated to maintenance. Governments should, therefore, cut back on the amount of new construction and improvement they undertake and use the funds so saved to increase the amount of preventative and periodic maintenance. Any funds available after this changeover should be used for reconstruction of pavements that have failed due to lack of maintenance.
Only after all of the above are done should funds be spent on new construction and improvements. In some countries, the reallocation of funds from new investment to maintenance would be sufficient to put the road network back into good condition. In others, however, reduction in the size of the road network is necessary if the country is to become self-supporting in respect of its road system.

To abandon parts of the road network is politically very difficult for governments to acknowledge and carry through. It is, however, a fact that a number of countries have developed a road system which is more than they can afford with their own resources at present levels of efficiency, and the network may be more than is necessary for present traffic needs anyway. Where a country cannot maintain its road system from its own resources and foreign aid on a continuing basis is not available for maintenance, either parts of the system must be abandoned or continuing deterioration throughout the whole network is inevitable.

The problem of pavement damage is exacerbated by the damage being done by overloaded vehicles. In most developing countries, overloading is rife and its control would reap great dividends in terms of road maintenance savings. There is more scope for the control of vehicle dimensions on import. Many developing countries allow vehicles to be imported that are illegal on the roads of Europe and North America because of an insufficient number of axles to spread the potential loads that can be carried.

Finance
It is essential that countries provide adequate finance for maintenance and to support this with an appropriate commitment of foreign exchange resources. In addition to the transfer of funds from other parts of the road sub-sector, there is scope for better cost-recovery through taxation to increase funding. In many countries, road haulage is subsidised by other sectors because of a failure to apply equitable taxation. In other countries, revenue earned through taxation of the road sector is spent elsewhere in the economy. Although, the disbursement of revenues is a political issue, consideration should be given to the use of earmarked taxes or road funds in those countries where road maintenance expenditure is inadequate or funds uncertain or irregular.
Efficiency

For maintenance operations to increase in efficiency, there is a need to strengthen management at all levels and to provide management training. Despite many years of technical assistance projects, there are shortages of skilled personnel in most countries. Training requirements are often underestimated and the need for retraining on a long-term continuous basis is often not appreciated. Although the need for staff training should be emphasised, any benefits will only be realised if trained staff are adequately reimbursed and provided with incentives to perform well. There is more scope for the restructuring of posts to make maintenance staff more senior and thus to provide the incentive for attracting the more able staff. The payment of productivity bonuses could be introduced in the same way as is common on new construction projects.

The use of private maintenance contractors has much to offer in terms of increasing efficiency, particularly for periodic maintenance, and countries should be encouraged to experiment with their use. There is also considerable potential use for labour intensive methods that will have a much lower requirement for foreign exchange, but have much greater need for management skills. In particular, 'lengthsmen' could be used to be responsible for the routine maintenance of fixed lengths of road and whose payment would depend on results.

The lack of working equipment is almost always a factor in maintenance organisations that are inefficient and there is considerable scope for improving the management of this expensive resource. The use of commercially-based hire charge systems is likely to inculcate greater cost-consciousness and efficiency. By making the financing of plant hire organisations dependent on revenues generated from hireings, there will be strong incentives to keep plant serviceable, since broken-down items produce no revenue.

In general, there is a much greater need for individual responsibility and cost-accountability at all levels, and it is important that a lead is given at the highest political level. Priorities for funding must be assigned, coupled with a determination to carry policies through without a diversion of resources to other peripheral activities. There is an increasing awareness of the road maintenance problem in many developing countries. What is needed now is a concerted effort by the countries themselves supported by coordinated and appropriate actions by bilateral and multilateral aid donors to build up institutions and to develop road maintenance capability.
9. ACKNOWLEDGMENTS

The work described in this paper forms part of the programme of the Overseas Unit of the Transport and Road Research Laboratory, United Kingdom, and the paper is published by permission of the Director.

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10. REFERENCES


