

THE WORLD BANK

Discussion Paper

TRANSPORTATION ISSUES SERIES

Report No. TRP1

*An Appraisal of Highway Maintenance
by Contract in Developing Countries*

Clell G. Harral, Ernesto E. Henriod,
and Peter Graziano

April 1986

Transportation Department

Operations Policy Staff

Discussion Paper, Transportation Issues Series, Report No. TRP1.

AN APPRAISAL OF HIGHWAY MAINTENANCE BY CONTRACT
IN DEVELOPING COUNTRIES

Clell G. Harral, Ernesto E. Henriod, and Peter Graziano

April 1986

Transportation Department
Operations Policy Staff
The World Bank

Copyright © 1986
The World Bank
1818 H Street, N.W.
Washington, D.C. 20433, U.S.A.

All rights reserved

This is a document published informally by the World Bank. The views and interpretations herein are those of the authors and should not be attributed to the World Bank, to its affiliated organizations, or to any individuals acting on their behalf.

This document is the third, updated, edition of a report dated March 3, 1982. It was prepared by Clell G. Harral, Transport Policy Adviser and Ernesto E. Henriod, Senior Construction Industry Specialist, both of the World Bank, and Peter Graziano, Vice President of de Leuw Cather & Co.

SYNOPSIS

The introduction of competitive practices in the performance of routine maintenance operations is gaining strength in many countries. In some cases, the move to contracting has been motivated by the rapid growth of maintenance needs, which exceeded available resources; in others, the contracting out of routine maintenance was motivated by the presence of intractable obstacles to the development of effective force account organizations.

This paper presents a review of the experience in nine countries with routine maintenance by contract. Those countries cover the whole spectrum of development, and their case studies reveal the advantages and potential pitfalls of contracting for this purpose. The authors conclude that, given a suitable planning and management organization within the contracting authority, and the prevalence of a truly competitive environment, the advantages of contracting can outweigh the disadvantages in terms, inter alia, of actual maintenance work carried out, cost effectiveness, flexibility in the management of resources, and support to the development of the national construction industry.

THIS PAGE
IS BLANK

TABLE OF CONTENTS

Preface to the 1986 Edition	vii
Summary	ix
I. Introduction	1
Contracting: Pro and Con	1
Study Objectives	3
II. The Brazilian Experience	3
Transition	4
Size and Duration of Contracts	4
Types of Contract	4
Planning and Procurement	5
Contract Management	7
Evaluation	10
Conclusions	15
III. Experience in Other Countries	16
Yugoslavia	16
Colombia	21
Argentina	25
Nigeria	28
Kenya	32
Ghana	33
Central African Republic	36
The United Kingdom	38
IV. Conclusions and Recommendations	39
General Conclusions	39
Under What Circumstances Should Contract Maintenance Be Considered?	41
How Should Contract Maintenance Be Introduced?	42

**THIS PAGE
IS BLANK**

PREFACE TO THE 1986 EDITION

The introduction of competitive practices in the performance of routine maintenance operations is gaining strength in many countries. In the World Bank we have been following, and in some cases assisted in the introduction of, such competitive practices. In a broad sense, they can be categorised in two types of action: (i) execution of routine maintenance by contract and (ii) the conversion of force account units to commercial or quasi-commercial operation, through making them accountable for the use of resources against preset performance standards, and ultimately having to compete for their work in the open market.

In 1982, we produced the first edition of this paper, which deals with the first subject, i.e., the execution of routine maintenance by contract. The paper was presented to the International Conference on Criteria for Planning Highway Investment in Developing Countries (London, May 1982). Since then, we have been gratified by the degree of discussion and interest generated, and by the surgence of a new body of literature on the subject. Some changes have occurred in the countries whose experience in contract maintenance was described in the first edition. Other countries have joined the throng of the practitioners, some with bold privatization measures, others starting at the basic stage of developing a domestic contracting industry that will increasingly take part in maintenance activities, while growing and strengthening with the stimulus of a steady workload. The experience in some of these countries is succinctly described in this edition, which only slightly updates that of June, 1985, presented to the Pan American Highway Maintenance Conference (Los Angeles, September 1985).

We present this as a discussion paper, hoping to contribute thoughts and experience towards the improvement of highway maintenance in the Bank's member countries. At a later stage, when more information has been gathered from a wider range of countries, this paper should be complemented with further cost comparisons of routine maintenance carried out by contract and by force account. It should also be complemented with other papers on practical guidelines (e.g., forms of contract) and policy aspects.

Meanwhile, we would welcome suggestions, and further information (particularly on organizational arrangements).

THIS PAGE

IS BLANK

SUMMARY

(i) While many road authorities have contracted for the performance of periodic maintenance -- because of special skills or equipment requirements, the short-term nature of the work activity, or the desire to avoid overburdening existing government capacities -- the practice in most government highway agencies has been to perform routine^{1/} maintenance with government forces, using personnel engaged on a full-time basis, and equipment owned and operated by the agencies. This has been a function of government for 100 years or more in most countries. However, in recent years, several governments have greatly increased the use of contractors in road maintenance, in many instances extending contracts to routine as well as periodic maintenance. Most were faced with maintenance needs growing more rapidly than resources, and thus sought greater cost-effectiveness. Others were faced with seemingly intractable problems in development of effective force account organizations and turned in desperation to contractors to get essential maintenance done at whatever cost.

(ii) This study was undertaken to review this experience and evaluate the prospects for contracting maintenance, particularly routine maintenance, more generally; specifically to provide a basis for determining whether, and to what extent, such contracting is desirable and applicable in developing countries. It has encompassed a detailed examination of the extensive experience with contracting of maintenance for federal highways in Brazil over the period 1970-82 (briefly updated for this edition), and shorter reviews of contract maintenance in Yugoslavia, Colombia, Argentina, Nigeria, Kenya, Ghana, the Central African Republic and the United Kingdom.^{2/} Yugoslavia has had even more extensive experience than Brazil with the contracting of routine as well as periodic maintenance, while major experiments are really just beginning in the other cases.^{3/}

(iii) The movement toward greater use of contractors in maintenance functions stems from general dissatisfaction with the performance of government force account organizations, whose problems are increasingly seen to be deep-rooted and difficult to solve. It is unfortunately true that government road

^{1/} Road maintenance activities are generally classified as either routine or periodic. Routine maintenance includes operations that normally are repeated one or more times a year (e.g., vegetation control, cleaning ditches and culverts, patching potholes and emergency repairs). Periodic maintenance includes operations which typically need to be repeated over longer than yearly cycles, primarily regravelling for gravel roads, and bituminous surface dressings or seals for paved roads.

^{2/} The Argentina, Colombia, and Nigeria reviews are considerably updated in this edition, Ghana, the C.A.R. and the U.K. are new entries.

^{3/} There is also a wider and growing body of experience in other countries, including the industrialized countries, e.g., several states and cities in the United States, and the Netherlands.

authorities in many countries face severe difficulties in attracting and retaining well-qualified management and skilled personnel, that bureaucratic formalities often hamstring effective management, that it is normally not possible to structure strong incentives rewarding superior performance and discouraging poor performance, and that government payrolls are often bloated with very large numbers of unproductive staff.

(iv) Thus, the arguments for contracting maintenance are related to both efficacy and efficiency. Contractors -- operating under strong incentives for efficiency, with freedom to pay competitive salaries and to hire and promote personnel on the basis of actual skills and performance rather than paper qualifications, with a better prospect for retaining the most productive and greater freedom to discharge the less productive staff -- may stand a better chance for developing a lasting institutional capacity, in the form of a dynamic industry, to provide effective and efficient road maintenance services.

(v) An important advantage in many cases is contractors' greater flexibility in scaling resources to meet specific needs and to scale back after peak demands are met, or when general budget cutbacks are required; in most force account organizations, because labor forces and payrolls are fixed, budget cutbacks have a much magnified effect on total output as the entire budget reduction is normally effected through reductions in purchases of fuel and other critical inputs. An additional advantage is that contractual commitment can provide better control over diversion of maintenance funds to non-maintenance functions, when those who benefit are forced to pay full costs for services rendered. Finally, in a context where road maintenance budgets in many countries are far below needed amounts, where contractors become involved in maintenance activities, their lobbying for increased budgets for maintenance can operate in the public interest.

(vi) The principal contrary arguments, which vary depending on local circumstances, include that contractors may not have the requisite capacity, or that those with the capacity are disinterested in small routine maintenance contracts (especially in remote areas), and/or that the Government may not have the capability to manage contracts effectively. Other commonly expressed concerns are that contracting maintenance may actually increase costs, because of increased administration (e.g., measuring and certifying quantities for payment), or increased redundancies (when government establishment cannot be reduced or relocated to the private sector), or because corruption in the procurement process prevents cost savings from being passed on to the public. Concern is also expressed that contractors' resources might not be available to government to help meet emergencies, such as earthquakes, famines, etc.

(vii) The experience in the nine countries reviewed here sheds light, both positive and negative, on these a priori arguments. Some mistakes have been made, but, in general, contracting of routine as well as periodic maintenance has proven to be efficacious. In most cases reviewed, roads are now being generally well maintained by contractors; in Colombia, initial problems encountered in the first small experiment have been largely overcome; in some cases maintenance work is now getting done where little was done before,

e.g., in the CAR and Nigeria; and in Kenya 14 small contractors accomplished 80 percent of the total road regravelling done during 1980/81. Major reductions in government establishment have already been achieved in two cases: in Brazil, where the DNER workforce is said to have been reduced by 60% over a decade (although exact figures are not available) and in Yugoslavia, where, with the most mature system in place, as few as six public employees (5 inspectors and 1 director) control 4,700 km of high standard, well maintained highways (in Slovenia).

(viii) In general, with sufficient profit incentives, contractors have been attracted to maintenance opportunities even in remote areas, and they have been willing to contractually commit their resources to the government in event of emergencies. While larger firms tend to prefer larger contracts including periodic maintenance, in many instances small firms have been formed specifically to undertake routine maintenance.

(ix) With respect to efficiency, the evidence is also promising, although very limited. While the cost of contracted work is available, comparable costs of similar operations by government forces are not generally available. In force account operations systematic recording of the amount of work achieved (as distinct from the resources consumed) is not generally done; moreover, the economic cost of government investment in plant and equipment is often overlooked. However, certain inferences can reasonably be drawn on the basis of the partial information which is in hand. Unit-price contracts clearly provide contractors with strong incentives for efficiency, and initial cost results from Brazil, Argentina, and Kenya (and also the United States) suggest that contractors can perform maintenance at substantially reduced costs. In the one case (from Ponta Grossa, Brazil) where fully comparable costs under similar conditions were available for both force account and unit price contracts, the force account operation, commonly viewed as a very efficient one, was 59 percent more costly. Brazil is currently undergoing conversion to unit prices for all maintenance contracts.

(x) It is concluded that the possibility of contracting some part or all of routine maintenance should be considered by every road authority. Those countries with a well developed domestic contracting industry should experience few problems in introducing maintenance contracting, provided careful planning and preparation is done. Retention of a nuclear force account unit capacity in competition with contractors, as was originally planned in Argentina, may be desirable to provide a source of comparative costs, help reduce the danger of monopolistic exploitation, and enhance government management flexibility.

(xi) Those countries with limited or non-existent domestic contracting industries typically also have limited institutional capacities for the execution of works by force account. In these cases the tasks of developing the necessary institutional capacities will be long and difficult no matter which course is pursued. Witness the efforts being made in the Central African Republic to form small contracting enterprises to carry out

maintenance. Where development of a domestic contracting industry is at all a feasible proposition, the strategy of limiting the burden on government as much as possible, concentrating development of its capacities on the management of contracts and fostering the development of the domestic contracting industry is an option which merits serious consideration.

(xii) It must be recognized, however, that the introduction of any new system engenders an element of risk. The early Colombian experience illustrates some of the problems which can be encountered in introducing contract maintenance with inadequate planning and preparation. While the overall burden of responsibilities on the road authority is normally reduced by the introduction of contractors, the nature of the Government's responsibilities changes sharply, and there is increased need for contract management skills. Careful planning and introduction of contracts on a small trial basis initially can reduce risks, permitting the capabilities of government and contractors alike to develop before thrusting too heavy a burden on a new system. All of the successful contracting schemes have involved close coordination between the Government and contractors in defining the work to be done and planning the work program. Thorough orientation of contractors prior to tendering promotes understanding of the tasks to be done, reduces perceived risks and risk premia included in tender prices.

(xiii) The majority of work should be done under competitively-tendered, unit-price contracts. A small element, typically not exceeding 10-15 percent of routine maintenance, could best be done under cost-plus arrangements to simplify administration of items which are difficult to measure, and also to add management flexibility (as, e.g. for emergency operations).

(xiv) Simplicity and maximum incentives are desirable features of the contract, and in general unit-price contracts have proved well suited to maintenance activities. However, standard forms based on construction activities are often unsuitable, and contractual instruments should be drawn specifically to fit the needs of routine maintenance. Many governments may wish to consider, at least initially, the use of a consultant or management services contractor in order to develop especially adapted management systems and contract instruments.

I. INTRODUCTION

1.01 While many road authorities have contracted for the performance of periodic maintenance -- because of special skills or equipment requirements, the short-term nature of the work activity, the ease with which periodic maintenance items can be organized into a contract package, or the desire to avoid overburdening existing government capacities -- the practice in most government highway agencies, at least until recently, has been to perform most routine^{1/} maintenance with government forces, using personnel engaged on a full-time basis, and equipment owned and operated by the agencies. This has been a function of government for 100 years or more in most countries, and the opportunities for stable employment with government security have been a boon for vast numbers of semi-skilled and unskilled road workers all over the world; indeed, in some cases the roads department has come to be seen as an instrument to provide unemployment relief, often without adaptation to the appropriate technologies.

1.02 However, government highway organizations in many countries are faced with severe difficulties in attracting, developing, and retaining well-qualified maintenance management and skilled personnel. Moreover, bureaucratic formalities frequently hamper the procurement and effective management of equipment, spare parts, materials, and labor, and often the full economic costs of government operations, e.g., interest on capital costs of equipment, are not incorporated in management decision making. Most importantly, it is normally not possible to structure strong incentives rewarding superior performance and discouraging poor performance. It should not be surprising that these problems result in ineffective, inefficient and costly maintenance operations in many countries, performed by a service monopoly which is usually not challenged by competition.

1.03 The recent, unusually severe worldwide phenomenon of general budgetary crisis for governments, which has hit road authorities with their dependency on petroleum products particularly hard, is now imposing a new urgency to the solution of these traditional problems. Indeed, in many countries there is need at the same time both for finding of ways to perform maintenance at lower unit costs and for increased levels of funding.^{2/}

Contracting: Pro and Con

1.04 One way to deal with the overabundance of problems in force account operations is through the use of contractors to perform highway maintenance services, including routine as well as periodic activities. Maintenance contracting has attracted increasing attention in recent years, because it can provide:

1/ Road maintenance activities are generally classified as either routine or periodic. Routine maintenance includes operations that normally are repeated one or more time a year (e.g., vegetation control, cleaning ditches and culverts, patching potholes and emergency repairs). Periodic maintenance includes operations which typically need to be repeated over longer than yearly cycles, primarily regravelling for gravel roads, and bituminous surface dressings or seals for paved roads.

2/ The overall problems of road maintenance in developing countries are discussed in more detail in the World Bank publication The Road Maintenance Problem and International Assistance (December 1981).

- (i) strong incentives for improvements in performance and economy;
- (ii) a more flexible operating environment in terms of managing resources, including greater flexibility in scaling resources to suit changing demands, thus facilitating improvements in cost-effectiveness;
- (iii) relief to the government from the burden of direct management responsibilities for large equipment fleets and work forces;
- (iv) the need to commit funds for maintenance contracts, with less likely diversion of resources to other activities;
- (v) political support for adequate and more stable levels of funding for road maintenance, provided the contractors can organize themselves into a responsible lobby, and
- (vi) a better prospect for developing a lasting institutional capacity, in the form of a pool of local contractors skilled in providing efficient and effective maintenance services. (Development of the potential to expand and undertake more extensive construction activities may be an important by-product).

1.05 Contrary arguments, which are often advanced when proposals for the contracting out of maintenance activities are being considered, include the following:

- (i) contracting may not decrease costs where redundant government establishment and work forces cannot be reduced or relocated to the private sector;
- (ii) contracting could increase costs because the very process of contracting and contract administration may require additional government resources, e.g., in measuring and certifying work quantities for payment;
- (iii) contracting may increase costs to the government where there is lack of effective competition in the procurement process, including abuses such as corruption in contractor selection or price fixing;
- (iv) government may not have the capabilities necessary to properly manage contracts;
- (v) domestic contractors may not have sufficient capabilities -- management abilities, technical skills, equipment, working capital, and other resources -- necessary to insure effective execution of maintenance activities; and
- (vi) contractors may not be well placed to respond quickly during times of emergency, nor to address small-scale maintenance needs in remote areas.

Study Objectives

1.06 In recent years highway authorities in several countries have, for various reasons, turned to contracting of routine as well as periodic maintenance. The present study was undertaken to review this experience and evaluate the prospects for contracting maintenance more generally. Since contracting of periodic maintenance is already a well-established, widely-accepted practice, the report concentrates on the issues of extending contracting to routine maintenance functions as well. Specifically, the objectives of this report are:

- to evaluate the experience of public highway agencies in contracting for road maintenance, particularly routine maintenance;
- to provide a basis for determining whether, and to what extent, such contracting is desirable and applicable in developing countries; and
- to detail the requisite conditions and provide guidelines for preparing the undertaking of maintenance by contract.

1.07 This report is based upon a detailed study of the extensive experience with contracting of maintenance for federal highways in Brazil over the period 1970-82 (somewhat updated for this edition), and a briefer review of contract maintenance operations in Yugoslavia, Argentina, Colombia, Nigeria, Kenya, Ghana, the Central African Republic, and the United Kingdom.^{3/} Yugoslavia has had even more experience than Brazil with the contracting of routine as well as periodic maintenance, while the other countries are working on major experiments. It is recognized that the countries covered by this study do not cover the whole range of conditions world-wide; nevertheless, there are some similarities in road maintenance management problems among all countries, and there may be a potential role for contractors in at least some maintenance functions in almost all countries.

II. THE BRAZILIAN EXPERIENCE

2.01 The use of maintenance by contract within the Brazilian National Highway Department (DNER) began in 1970; previously DNER had performed all maintenance on the federal highway network by force account. However, in the context of a rapidly growing network, limitations on hiring and pay scales were placed on the DNER by the Federal Government. This decision ultimately forced the majority of the maintenance establishment outside the national roads authority.

2.02 DNER has subsequently contracted maintenance of federal roads to state road authorities and the army (through negotiated contracts termed "delegation") and, for paved roads only, to private contractors (through competitive tendering). Initially, heavier reliance was placed on delegation where the existing establishment of the state road authorities could also

^{3/} The Argentina, Colombia, and Nigeria reviews are considerably updated in this edition; the reviews on Ghana, the C.A.R., and the U.K. are new.

accommodate federal roads thus reducing unnecessary duplication, but subsequent to 1974 the major growth has been met by expanding the role of contractors. Meanwhile, the size of the network maintained by DNER direct force account decreased from 41,816 km in the peak year of 1973 to 9,970 km in 1984, when private contractors accounted for the maintenance of 30,100 km and the states for 22,310 km of federal highways. Since the states operate predominantly in a force account mode, we focus subsequently on the DNER experience with private contractors.

Transition

2.03 The gradual phasing in of private contractors to maintenance activities -- over the first four years roads under contract rose gradually to only 5,764 km in 1973 -- helped ease the transition process in Brazil and provided a helpful base of experience for the rapid expansion (to 17,499 km) which took place in the two years 1974-1975. In subsequent years, growth in contract maintenance has been only slightly more rapid than the growth of the federal network, so that the absolute size of the network directly maintained by DNER has been relatively constant since 1976, with a modest decrease in 1980. Most reductions in DNER personnel and equipment fleet have been effected through natural attrition. Although exact figures are not available, the DNER work force is said to have been reduced by approximately 60 percent over the first decade of the application of the Government hiring restrictions, while the size of the network directly maintained by DNER had decreased by about 76 percent by 1984. Thus, the government has ultimately been largely successful in reducing the size of its establishment, although it has taken several years to do so, and it chose to carry the costs of some transitional redundancy in order to ease the difficulties of staff affected.

Size and Duration of Contracts

2.04 By mid-1981, 264 contracts for routine maintenance were in force. The size of contract was typically small, averaging just under 100 km (with most falling in the range 90-130 km) and having a value in the range of US\$400,000-1,400,000 per annum, including in some cases betterments and periodic as well as routine maintenance in the same contract. However, after studies showed that larger contracts tended to reduce costs by substantially increasing equipment utilization throughout the year, the DNER gradually increased the size of its contracts, until they reached an average of 270 km in 1985. The contract is initially for two years' duration, but is normally renewed annually for an additional three years. After five years, the contract must be retendered.

Types of Contract

2.05 In 1981, two types of contract were being employed. The first type of contract to be employed and by far the dominant type in 1981 -- all but three of 264 -- was cost-plus-percentage-fee. Under this type of contract, as practiced in Brazil, the contractor only supplied labor, equipment and materials, while the main burden and responsibilities for directing the use of these resources to actually perform the work remained with DNER; heavy demands continued to be placed on DNER field personnel to provide on-site man-

agement, little different from force account operations. In an attempt to transfer the major burden for direct management of the worksite to the contractor, thus relieving the increasingly severe workload on the dwindling DNER supervisory staff, and also to reduce costs, DNER initiated three unit-price contracts in 1979. The unit-price contract ties the payment to the work achieved, and it alters fundamentally the respective roles of DNER and the contractors. The management responsibilities, risks and profit opportunities for the contractor are all greatly increased, and DNER professional personnel are freed to concentrate on the higher level management functions of planning, work identification, scheduling, quality control, measurement, and payment. The results obtained from the three initial unit price contracts, and the additional experience gathered since 1979, has led the DNER to totally phase out cost-plus contracts.

Planning and Procurement

2.06 The planning process for cost-plus contracts as practiced in Brazil was not very rigorous, limited essentially to aiming at rough estimates of resource requirements, while responsibility for defining the work program, supervising resources and coping with any cost increases remained with DNER. Planning for unit price contracts is necessarily a more systematic process, as a careful definition of the work program is essential when payment is based on work accomplished, and responsibilities for resource management and cost control are transferred to the contractor. The annual planning process of unit-price contracts includes:

- identification of maintenance activities and their units of measure;
- an inventory of physical highway elements (and condition, for the more important elements such as pavement);
- the selection of annual quantity standards for each maintenance activity;
- the development of performance standards for each maintenance activity;
- the development of an annual work program; and
- the development of a balanced work calendar for performing the work, month by month throughout the year.

2.07 By encompassing these elements of any well-planned maintenance program in the annual planning process for unit-price contracts, DNER establishes what is expected of the contractor and reduces the risks which would otherwise possibly scare some contractors away from tendering and which would be translated into increased tender prices. Table 1, which is taken from a bid document prepared by DNER, shows the type of planning information which is made available to the contractors at the outset, and which later forms the basis for regularly updated work programs.

Table 1

Brazil

Estimated Monthly Percentage Distribution of Work per Item
(From DNER bid documents)

DNER
ROAD: BR-407/BA
Total length: 229.7 km
Location: R-5/11 (Senhor do Bonfim)

Percentage monthly distribution of work

Work Item	Quantity	Unit	Percentage monthly distribution of work													
			I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
Pothole patching	30	m ³								20	20	20	20	20		
Asphalt-cold mix	33	m ³								20	20	20	20	20		
Transport in tip trucks	5,440	T-km								20	20	20	20	20		
Cleaning curbs and gutters	25,000	m	10	10	10	10	5	5	5	5	10	10	10	10		
Manual ditch cleaning	1,500	m	10	10	10	10	5	5	5	5	10	10	10	10		
Culvert cleaning	227	unit											30	40	30	
Manual excavation	400	m ³	10	10	10	10	10	10	10	10	10	5	5	5	5	
Compacted fill	400	m ³	10	10	10	10	10	10	10	10	10	5	5	5	5	
Concrete, as specified	200	m ³	10	10	10	10	10	10	10	10	10	5	5	5	5	
Formwork etc.	1,710	m ²	10	10	10	10	10	10	10	10	10	5	5	5	5	

Note: Activity codes have been omitted, as have several items listed after 'formwork'. At the bottom of the form, there is space for the contractor to write-in the monthly and accumulated values of work, at his bid prices.

2.08 One unit-price table is used for planning and budgeting throughout the entire country; regional price differences will, of course, be taken into account within the bidding process. Table 2 contains the standard unit-price table for DNER activities estimated for May 1980 and May 1984. In addition, unit prices for a series of material production activities are also estimated and included in the set of unit-price tables. The unit-price tables were developed by the staff of the Central Maintenance Directorate (CMD), initially with the aid of consultants. CMD is also responsible for updating the tables, whose format has remained unchanged to date. With inflation reaching triple digits, price indexing is important to contracts in Brazil. In 1980, tables were being updated quarterly; then were later adjusted monthly according to a price indexing procedure, with a more thorough annual updating, usually in May.

2.09 Contractor Qualification. Until the early 80's, the same qualification criteria were being used for unit-price as for cost-plus contracts, geared to a contract which included not only maintenance but also some provision for betterment work, which would normally require a medium-or large-size contractor. Thus, standard requirements in terms of technical and financial capacity, ownership and availability of equipment were higher than they need be for routine maintenance, and in the period up to 1980 25-40 percent of contractors tendering were being disqualified. Qualification criteria were modified later to suit the majority of contracts which involve only routine maintenance, and competition and cost-effectiveness improved. Also, there has been a trend to increase the size of contract, seeking to obtain lower costs through economies of scale. Interim figures obtained in 1985 suggest that this is being achieved.

2.10 Tendering Competition. Maintenance contracts are competitively tendered by DNER. An examination of a sample of 180 cost-plus tenders carried out in 1981 showed that 45 percent attracted 6 or more bids each, while more than two-thirds attracted at least three bids. The majority of those attracting fewer bids were contracts which were being retendered because the legal maximum five-year contract period had been reached, and it was presumed that the current contractor's existing base and knowledge of specific circumstances had tended to discourage competitors. Also, the size of the contract appeared to influence the degree of competition: about 7,000 km containing some betterment work, with costs in excess of US\$7,500 per kilometer, attracted the largest number of bidders.

Contract Management

2.11 Contract management includes work scheduling, quality control, measurement of resources consumed (cost plus) or work accomplished (unit price), and certification for payment. Under the unit-price contract these functions differ considerably from control of activities under force account; we will now focus on the unit-price approach.

2.12 Work Scheduling. Work scheduling on the unit-price contracts, as practiced in Brazil, is a joint effort shared by the DNER and the contractor. DNER personnel are responsible for identifying field maintenance work needs (the type and amount of work to be performed and its specific location). The

Table 2

Brazil

Maintenance Directorate - Maintenance Division
Highway Maintenance Costs
Activity Unity Costs

<u>Description</u>	<u>Unit of Measure</u>	<u>Unit of Cr.\$ (May 1980)</u>	<u>Unit Cost 1,000 Cr.\$ (May 1984)</u>
Asphalt Pothole Patching	m ³	4,231.79	93.64
Deep Asphalt Patching	m ³	3,534.79	113.05
Cleaning and Filling Slab Joints	100 m	1,109.00	33.75
Sealing Asphalt Cracks	100 L	2,674.00	81.83
Cleaning Curbs and Gutters	100 m	232.00	5.55
Manual Ditch Cleaning	100 m	348.00	8.32
Culvert Cleaning	unit	273.36	6.54
Repair of Guardrail	m	469.22	14.96
Manual Grass Cutting	100 m ²	41.00	1.01
Mechanized Grass Cutting	100 m ²	21.00	0.97
Manual Cutting of Vegetation	100 m ²	309.00	7.40
Chemical Control of Vegetation	100 m ²	15.00	0.47
Gravel Patching	m ³	523.68	15.31
Blading Gravel Roadways	100 m ²	28.00	1.13
Sign Repair	m ²	254.37	7.34
Repair of Pavement Reflectors	unit	31.32	0.75
Repair of Metal Guardrail	m	29.42	0.71
Painting with Lime	100 m ²	1,675.00	11.23
Repair of Glare Deflectors	m	477.12	11.42
Manual Striping	m ³	1,057.00	25.27
Repaving Asphalt Surfaces with Hot Mix	m ³	2,514.08	40.93
Repaving Asphalt Surfaces with Cold Mix	m ³	1,498.20	39.01
Repaving Asphalt Surfaces with Sand	m ³	2,031.11	24.22
Asphalt Hot Mix			
Sealing	100 m ²	610.00	17.64
Slurry Sealing	100 m ²	642.00	17.92
Repaving Asphalt Surfaces with Sand	m ³	1,162.51	16.36
Asphalt Cold Mix			
Control of Asphalt Bleeding	m ²	47.77	1.50
Repair of Concrete Slab	m ³	3,632.39	97.01
Reforming Gravel Surfaces	m ³	159.34	47.02
Cleaning Bridges	m	46.25	1.26
Manual Repair of Embankments	m ³	604.05	10.74
Mechanized Repair of Embankments	m ³	183.14	5.32
Manual Removal of Landslides	m ³	204.31	6.44
Mechanized Removal of Landslides	m ³	147.57	4.06
Construction of Drainage Structure	m	507.58	13.33
Construction of Slope Benches	m ³	161.02	3.85
Embankment Protection with Turf Blocks	100 m ²	161.00	3.85
Tree Planting	unit	164.10	—
Reshaping of Right-of-Way	m ²	5.91	—
Construction of Stone Masonry	m ³	1,059.78	—

Rate of Exchange May 1980 US\$1 = Cr.\$ 49.750
May 1984 US\$1 = Cr.\$1,582.001

needs in the form of a work order are transmitted to the contractor at weekly scheduling meetings at which work objectives and work progress are discussed. Subsequently, it is the contractor's responsibility to assign and allocate his manpower, equipment, materials and time to meet the needs, within the contractual unit rates.

2.13 Quality Control. Contractors are provided with performance standards which also indicate the procedure to be followed ^{4/}; the unit-price contract agreement also stipulates that if work quality is sub-standard, the resident engineer may require it to be replaced at the contractor's expense. In addition to random on-site inspection, the quality of work can also be examined during measurement. The experience to date suggests quality control is not a major problem; this is mainly because the quality of most important elements of maintenance (e.g., mowing and drainage clearance) is clearly visible in the end result. However, for those few important activities where poor work can be hidden (such as asphalt patching or bridge rehabilitation), quality control by frequent observation of work procedures is warranted.

2.14 Inspection Procedures. In 1980 it was forecast that, as unit-price contracts came to replace cost-plus, DNER's inspection force could be reduced to three per "residencia" (a unit covering 350-500 km), including a specialist in asphalt paving, one for concrete and improvement works, and one for general activities. Working under the assistant residencia engineer, these three inspectors would certify quantity as well as quality of work. As additional experience is gained, it should be possible eventually to reduce the inspection duties to one inspector per residencia, further reducing manpower requirements. Information on this aspect has not yet been updated, and we therefore cannot confirm whether the DNER plans for reducing the supervision staff were achieved in practice.

2.15 Work Measurement and Payment. Table 2 lists the basic work activities and the units by which they are measured. DNER has found that approximately 90 percent of the activities are easy to measure according to unit-price specifications. However, difficulties have been found with about 10 percent of activities. These problems involve difficulties in predicting and measuring the quantity of work according to the specified units of measure. Inequities can result from the unit selected as a basis of payment. For example, repairs of broken concrete structures such as ditches may require for the same length of repair varying amounts of manual excavation, materials and labor depending on the degree of repair needed. A simple unit of measure is often inadequate to express either predicted or accomplished work quantities. Attempting to measure the work for these types of activities using a unit-price concept generally results in excessive and unwarranted administration. As a result of these difficulties, unit-price contracts contain a cost-plus element of about 10 percent of the total value of the contract to cover such activities.

^{4/} The procedure-type specification (or the cook-book approach) was also applied in Argentina, and is particularly useful at the introductory stage of a contract maintenance system, when contractors are learning the operational requirements of highway maintenance.

2.16 Training. In 1979, prior to the introduction of unit-price contracts in the three pilot residencies, the district and residency engineers, inspectors and clerks were trained in various concepts and procedures associated with contract management. The training began with a one-day seminar on the concepts on the DNER Maintenance Management Systems (SAC). The seminar included such topics as planning, programming and budgeting, organizing and staffing, scheduling, and work reporting. The seminar was followed by local training in each residency. This training began with one or two days spent with each resident engineer reviewing the maintenance management system concepts and procedures. Following these sessions, the resident engineer, inspectors and clerks were presented with separate case problems. The case problem for resident engineers and inspectors dealt with planning and scheduling while that for clerks involved record keeping and the use of forms. The data for these case problems were taken from actual maintenance planning, performance and control records for that residency. Finally, follow-up visits to each residency were conducted on one to two-month intervals. During these visits, additional training was provided and specific, current problems were discussed.

2.17 In addition to the training of DNER personnel, one day of orientation was provided to each of the key members of the initial contractors' staffs. The training included classroom presentation with visual aids and case problems. The topics included planning, scheduling, work measurement, work reporting, preparing forms, and basic accounting procedures. Most importantly, DNER continued to provide on-the-job management assistance to the contractors on the pilot unit-price contracts. As the system of unit price contracts has expanded to embrace all contracted maintenance, the training of DNER and contractors' staff has continued, following the patterns devised in the experimental period.

Evaluation

2.18 Two analyses of the cost-effectiveness of maintenance operations by contract were done in 1981, where comparable activities and data were available. The first compared only manpower productivity (production unit per man-day) among labor-oriented routine maintenance activities for all three modes--force account, cost-plus contract, and unit-price contract; such comparisons must be interpreted carefully, since they do not take account of other inputs, most importantly, equipment (and its operating costs). The second was a comprehensive cost comparison between an entire force account operation and a DNER unit-price contract in the State of Parana.^{5/}

2.19 Productivity. The DNER collected productivity data on its maintenance operations for force account projects, cost-plus and unit-price contracting in the States of Parana, Pernambuco and Rio Grande do Norte. The productivity data are shown in Table 3. It will be seen that of the five activities constituting 88.4 percent of total costs, the highest productivity for

^{5/} A wider-scope cost effectiveness study (comparing contract and force account work) is currently being undertaken by DNER. Results are not available at the time of writing this update.

Table 3

Brazil

Productivity* Comparisons of Labor-Oriented Activities for
Force Account, and Cost Plus and Unit-Price Contracts

	Percent Total Cost	DNER Performance Standards	Force Account		Cost Plus		Unit Price		
			PONTA GROSSA PARANA 1979	PONTA GROSSA PARANA 1980	CARUARO PERNAM- BUCO 1979	ARCO VERDE PERNAM- BUCO 1980	PONTA GROSSA PARANA 1979-80	CARAURO PERNAM- BUCO 1980	CORRAIS NOVOS RIO GRANDE DO NORTE 1980
Pothole patching (m ³)	36.1	0.71	0.30	0.45	0.43	0.49	0.48	0.29	0.36
Cleaning curb and gutter (m)	2.7	227.00	170.6	164.6	176.3	202.0	245.3	108.4	403.0
Manual ditch cleaning (m)	1.4	150.00	93.0	92.0	--	--	166.6	36.1	--
Culvert cleaning (units)	0.6	1.00	0.96	1.01	--	--	2.14	0.65	2.02
Repair of bridge rail (m)	0.3	3.00	1.76	2.18	--	--	2.67	--	0.41
Manual vegetation control (m ²)	20.0	1,363.00	1,355.0	1,361.9	795.3	1,083.9	1,968.9	1,336.5	1,099.8
Manual weeding (m ²)	11.2	205.00	183.1	172.6	187.3	185.8	96.1	--	--
Fence repair (m)	1.9		31.4	15.5	--	15.6	18.3	--	20.5
Sign repair (m ²)	2.6	2.00	13.71	7.73	3.95	--	8.31	2.52	--
Repair roadside markers (units)	1.3	20.00	36.13	36.23	12.57	--	10.61	13.85	--
Repair metal guardrail (m)	.1	3.60	34.28	7.47	--	6.57	4.29	3.80	--
Painting curb and gutter (m)	12.7	182.00	126.8	88.9	144.8	148.2	212.9	118.1	301.1
Manual slope repair (m ³)	8.4	1.50	--	1.24	--	1.43	5.22	1.00	2.4
Manual slide removal (m ³)	1.0	7.00	2.68	1.21	--	--	7.04	3.30	--

* Productivity measured in production units per man day.

three of those activities was obtained under unit-price contracting. For a fourth, pothole patching (the largest single activity), manpower productivities were very little different among the three different modes of execution. Only in one of the activities, manual weeding, which was a major component (11.2 percent) of the total costs of all operations compared, was manpower productivity higher in both force account and cost-plus contracts than in unit-price contracts; however, under the unit-price contract this activity constituted a negligible proportion of total costs, so that it was not important enough to warrant the contractor's attention or result in economies of scale. On the other hand, it should be noted that one of the unit-price contracts (Caruaru) records extremely low productivities in almost all operations. An interview with the contractor's representative revealed that he had been ill-prepared for the financial and management responsibilities of unit-price contracting and his program was in disarray, partly because of government cutbacks in budget.

2.20 Cost-Effectiveness. In only one case (for Ponta Grossa, Parana) were data available to permit a comprehensive cost comparison between comparable force-account and unit-price operations. The comparison was made possible because in Ponta Grossa the cost accounting system for force account had developed to the extent that all indirect, as well as direct costs, were properly accounted and distributed, including interest on equipment.

2.21 The Ponta Grossa force account operation is considered one of the most efficient within the DNER. Its indirect costs for the eleven months studied were 36.5 million November 1980 cruzeiros (64 percent of total costs). Thus, the total costs for this operation were approximately 2.8 times its direct costs. Of the direct costs, only 40 percent could be classified as normal maintenance activities. The remaining 60 percent included rehabilitation, resurfacing, betterments and aid to other entities. The direct costs of routine maintenance, plus the distributed indirect costs, and, where applicable, the production and cost per unit of production are shown in Table 4 for this force account operation.

2.22 Similarly, the unit-price contract in Ponta Grossa is an efficient operation. This was indicated by the productivity figures. Its indirect costs for the eleven months studied were 2.8 million November 1980 cruzeiros (46 percent of total costs). Total costs were approximately 1.8 times the direct costs. The indirect costs also include the pilot experiment control and accounting functions, which would be eliminated in the future. Most of the activities in this operation can be considered normal routine maintenance, except fence construction which accounted for about 35 percent of the total costs. Table 4 contains the cost and production information for this contract.

2.23 An examination of Table 4 reveals that twenty activities were common to the two operations and thus directly comparable. Using the sum of the costs as a weight, and the ratio of the unit costs (force account to unit-price contract) by activity, a rough cost-effectiveness analysis was possible. This analysis is illustrated in Table 5. The weighted average for the ratio of unit costs was 1.59, indicating that for the same work, the force account operation was 59 percent more costly, or that the unit-price contract was about 37 percent more cost effective.

Table 4

Brazil
(Parana State)

Costs and Production for Force Account Project/
Unit Price Highway Maintenance Contract

Activity	Force Account ^{1/}			Unit Price ^{2/}		
	Cost ^{3/} (1000 Cr\$)	Production	Costs per unit of Production (Cr\$)	Cost ^{4/} (1000 Cr\$)	Production	Costs per unit of Production (1000 Cr\$)
Pothole patching (m ³)	1,726.21	172.52	10.005	1,986.99	235.75	8.43
Clean curb and gutter (m)	92.84	19,420	4.78	128.11	42,546	3.01
Manual cleaning ditch (m)	906.33	80,123	11.31	216.88	58,490	3.71
Culvert cleaning (units)	416.73	488	853.95	177.47	565	314.11
Repair surface drains (-)	149.15	--	--	466.70	--	--
Repair bridge rail (m)	198.62	214	928.13	49.29	50	985.80
Manual vegetation control (m ²)	3,487.91	4,307,162	0.8097	2,245.59	8,469,428	0.27
Mechanical grass cutting (m ²)	2,612.14	7,629,990	0.3423	2,522.29	4,721,370	0.52
Manual weeding (m ²)	611.85	96,435	6.34	76.89	9,900.35	7.77
Chemical weeding (m ²)	276.08	123,000	2.24	784.05	338,908	2.31
Clearing fire lane (m)	--	--	--	381.19	42,260	9.02
Gravel patching (m ³)	6.86	17	403.53	--	--	--
Blading gravel surface (m ²)	1,219.44	1,420,800	0.8583	--	--	--
Fence repair (m)	387.12	6,105	63.41	--	--	--
Sign repair (m ²)	1,560.70	1,421.98	1,097.55	38.13	182.91	208.46
Repair roadside markers (units)	1,600.68	10,145	157.78	378.30	1920	197.03
Repair metal guardrail (m)	45.69	216.5	211.04	379.16	611.35	620.20
Painting curb and gutter (m)	36.92	2,400	15.38	158.74	36,862.5	4.31
Clean and paint bridges (m)	10.81	180	60.05	40.30	360.70	111.73
Other routine maintenance	175.76	--	--	--	--	--
Resurfacing (m ³)	3,487.12	567.84	6,141.03	--	--	--
Regraveling (m ³)	128.25	502	255.48	--	--	--
Other preventive maintenance (-)	2.75	--	--	--	--	--
Manual repair of slopes (m ³)	27.73	26	1,066.54	129.28	1,025	126.13
Mechanical slope repair (m ³)	1,045.19	19,710	53.03	333.22	2,217	150.30
Manual removal of slides (m ³)	15.86	17	932.94	317.92	1,994	159.44
Mechanical removal of slides (m ³)	1,102.90	18,108.3	60.91	1,588.81	11,882.5	133.71
Other emergency maintenance	90.79	--	--	--	--	--
Restoration maintenance (-)	7,835.53	--	--	--	--	--
Culvert construction (units)	24.04	1	24.04	--	--	--
Plant trees (-)	5.99	--	--	--	--	--
Concrete ditch construction (-)	--	--	--	218.73	--	--
Earth ditch construction (m ³)	--	--	--	12.66	108.36	197.67
Fence construction (m)	485.25	2,180	222.68	7,255.90	36,708	196.67
Other betterments complementary (-)	3,220.04	--	--	--	--	--
Leveling roadway (m ²)	2,395.34	1,481,890	1.616	--	--	--
Other betterments modification (-)	6,239.67	--	--	--	--	--
Preparation of asphalt mix (m ³)	3,049.24	830	3,673.78	894.48	279.16	3,204.18
Place concrete culvert (m)	38.60	82	470.73	--	--	--
Sign production (-)	869.71	--	--	--	--	--
Production of anchor post (units)	--	--	--	333.45	543	614.09
Production of support posts (units)	--	--	--	5,012.91	12,261	408.85
Production of bridge rail (m)	--	--	--	4.15	36	115.28
Production of wood items (-)	469.29	--	--	--	--	--
Aid to federal police	4,552.73	--	--	--	--	--
Aid to others (-)	6,182.52	--	--	--	--	--

^{1/} Ponta Grossa, Parana: 185.5 km; January through November 1980; in cruzeiros of November 1980. Rate of exchange: US\$1 = 61.3 Cr.\$

^{2/} Ponta Grossa, Parana: 75.5 km; October 1979 through September 1980 excluding December 1979; Costs in cruzeiros of November 1980. Rate of exchange: US\$1 = 61.3 Cr.\$

^{3/} The costs in the column contain the following indirect costs distributed in proportion to the direct cost component costs in thousands of Cr.\$: administration - 22,925.65; personnel leave - 5,358.86; unproductive personnel time - 1,044.16; general transportation - 4,988.35; and unproductive equipment - 2,300.14.

^{4/} The costs in this column contain the following indirect cost distributed in proportion to the direct cost component costs in thousands of Cr.\$: Administration - 8,676.59; personnel leave - 165.35; unproductive personnel time - 202.52; general transportation - 2,412.74; and unproductive equipment - 25.46

NOTE: Unit costs in this table are not comparable to the unit price table because they contain material and DNER overhead and material costs.

Table 5

Brazil
(Parana State)

Comparison of Force Account to
Unit Price Costs per Unit of Production

<u>Activity</u>	<u>Sum of Force Account and Unit Price Costs</u>	<u>Ratio** of Costs per Unit of Production (Force Account over Unit Price)</u>
Fence Construction	7,741.15	1.13
Manual Vegetation Control	5,733.50	3.05
Mechanical Grass Cutting	5,134.43	0.64
Preparing Asphalt Mix	3,943.72	1.15
Pothole Patching	3,713.20	1.19
Mechanical Slide Removal	2,691.71	0.45
Repair Roadside Markers	1,978.98	0.80
Sign Repair	1,598.83	5.26
Mechanical Slope Repair	1,378.41	0.35
Manual Ditch Cleaning	1,123.21	3.05
Chemical Weeding (Shoulders)	1,060.13	0.97
Manual Weeding (Shoulders)	688.74	0.82
Culvert Cleaning	594.20	2.72
Repair Metal Guardrail	424.85	0.34
Manual Slide Removal	333.78	5.85
Repair of Bridge Rail	247.91	0.94
Cleaning Curb and Gutter	220.95	1.59
Manual Slope Repair	208.12	8.46
Painting Curb and Gutter	195.66	3.57
Cleaning and Painting Bridges	51.11	0.54
Weighted Average		1.59

* Activities are ranked in descending order according to the sum of the total activity costs for unit price contract and the force account project.

** Ratio = $\frac{\text{Cost per unit of production of force account}}{\text{Cost per unit of production of unit-price contract}}$

2.24 Additionally, an examination of the force account direct and indirect costs (footnoted in Table 4) indicates the vulnerability of the cost-effectiveness of the government operation to budget reductions. As the largest activities (rehabilitation and re-surfacing, which currently absorb a large part of the indirect costs) are reduced, unit prices for normal maintenance activities could rise considerably because indirect costs are fixed.

Conclusions

2.25 Overall experience over well over a decade clearly shows that in the Brazilian context contracting of routine as well as periodic maintenance is workable and efficacious: an expanding network of roads has been maintained to reasonable standards, while the Government has been able to reduce its establishment by virtually two-thirds. An important advantage of contracting has been greater flexibility of resource dimensioning and balancing; contractors more easily gear up for peak demands, reduce when demand slackens and more quickly change the mix of their resources to fit the changing nature of the work. Where the costs of labor and equipment are fixed, as is normally the case in force account operations, even a small decrease in total budget has a magnified effect on output, since the entire decrease must be absorbed by reductions in fuel and other material inputs necessary to work operations.

2.26 The difference in cost-effectiveness, however, as a rule is very hard to quantify, primarily because of the absence of comparable cost and performance data for government force account operations; in government accounts an important economic cost component, interest on the investment in plant and equipment, is generally omitted, and estimates of the establishment overheads attributable to maintenance operations are generally not available. Certainly the cost-plus-percentage-fee type contract, which was the primary mode of contracting in Brazil in the 70's suffers from severe shortcomings, particularly the absence of incentives for efficiency. Also, the burden of administration of cost-plus contracts was very little different, perhaps marginally a bit less, than the administration of force account works. Much of the burden of management, and all the risks of cost overruns, continued to be borne by the government under this type of contract.

2.27 The experience obtained in the trial period with unit-price contracting was promising, and led to continued reductions in direct costs and government establishment. It was feared in 1981 that the group of contractors then established and adapted to cost-plus contracting, whose lobbying for work had provided a helpful source of support for increased maintenance budgets, would not wish to encourage further development of unit-price contracting, since unit-price contracts pose a very different type of business approach, with much greater management responsibilities, risks, and profit opportunities. It was also feared that many contractors then engaged in cost-plus contracts would be unqualified or uninterested in competing under unit-price contracts. Nevertheless, it was anticipated that other contractors who were well placed, including those experienced in unit-price construction contracts, would be tempted by the new profit opportunities in maintenance. Time has proven the fears were unfounded, as cost-plus contracts are being phased out, and costs have continued to drop.

2.28 Average costs per km dropped between 1983 and 1984, in constant terms, from an average of CR\$2.7 million in 1983 to CR\$2.0 million in 1984.^{6/} While there has been a reduction in the volume of work being carried out, reports suggest a tendency for the average costs per km to continue dropping. One obvious reason for this would be the increased competition induced by the reduction in the number of contracts, coupled with the added attractiveness of the longer maintenance "lots" and the accession of a larger number of contractors to the bids, as prequalification requirements were relaxed. The reduction in the overall availability of construction work in the market at large no doubt also helped to increase the competitive edge. To assist in the expansion of resources necessary to undertake larger contracts, DNER has been making available its equipment, on hire, to the contractors.

III. EXPERIENCE IN OTHER COUNTRIES

3.01 Many other countries, including the industrialized countries of Europe and North America^{7/} as well as developing countries in Africa and Latin America, have had varying degrees of experience with contracting road maintenance. Resurfacing and regravelling operations and subactivities such as the supply of asphalt, aggregates and haulage, are very commonly contracted, with generally satisfactory results. Here we select eight additional cases which offer some instruction, both positive and negative, relevant to the interests of developing countries which may be considering initiating or expanding the use of contractors as an alternative to the traditional government force account establishment. These eight cases are drawn from Yugoslavia, Colombia, Argentina, Nigeria, Kenya, Ghana, The Central African Republic and the U.K. Since Yugoslavia has had by far the most extensive experience in contracting routine maintenance, we deal with it first.

Yugoslavia

3.02 Yugoslavia is a socialist federal republic consisting of six republics and two autonomous provinces. Since the mid 1950s, government administration and authority throughout much of the economy has increasingly been characterized by the separation of those who invest tax monies from those who execute the work; there has also been a general decentralization of decision-making to and within the individual republics. This general pattern of devolution has also applied to the highways sector. The maintenance functions of the highway agencies were essentially split in two during this period. The roads community retained annual work planning and contract management as the investor or custodian of the public interest, while the service or work exe-

^{6/} Source: DNER. Deflators from "Cojuntura."

^{7/} Contracting is increasingly used also in the United States and some European countries, e.g., the Netherlands. Recent experience, generally favorable, with contracting of routine maintenance at the city and state level in six American states--Arizona, California, Colorado, Florida, Pennsylvania and Texas--was reported at two US Transport Research Board Annual Meetings (Washington, D.C. January 1982 and 1984). The primary motivation in these cases has been to reduce costs, but the State of Texas has also sought the additional objectives of reducing government personnel and promoting the development of small contractors.

cution agency was transformed into a type of cooperative enterprise, or contractor. By introducing contractors, a system of incentives promoting efficiency was created, with employees sharing in the profits of the enterprise. Almost all maintenance activities for a highway network slightly in excess of 100,000 kilometers, encompassing a broad range of climates and terrain, have been placed under contract to these enterprises, including winter snow removal and other emergency maintenance.

3.03 The system has worked well, and the roads of Yugoslavia, many parts of which are heavily trafficked, are generally well maintained. A high degree of professionalism has evolved, accumulating years of experience into a well codified and well understood system which is administered with a minimum government establishment. The responsibilities of contractors (which may vary among the republics), are well defined in a body of regulations, a general agreement, and separate standard forms of contract custom-tailored to specific functions, e.g., routine maintenance, winter and emergency maintenance, major pavement maintenance, betterment work, and protection services (such as vehicle weight and size control). Technical standards, levels of service to the road user, work safety standards, response to emergencies are all well delineated contractually. The contractor is not only liable to the community for noncompliance, for which a series of monetary penalties may be invoked, but he may also be held liable to the road user for damages resulting from delays in timely execution of maintenance work. Such penalties, though not commonly exercised, are said to be seen by the enterprises as serious threats in the event of nonperformance.

3.04 Contract Management. Contract management in Yugoslavia has evolved into a highly effective system, ensuring adequate quality control, accurate work measurement and payment, with maximum simplicity and minimum cost. Two key factors in this success are the well-qualified inspectors, who spend the majority of their time in the field, and the use of sensible sampling procedures in field control.

3.05 Inspectors of the communities spend an average of three days per week on the roads under their responsibility, recording data and coordinating with the enterprise. Their objectives are:

- to identify where maintenance activities are needed for scheduling purposes;
- to obtain sample measurements of completed work;
- to inspect the quality of work performed; and
- to obtain both measurement of physical resources utilized and of work completed to document payments for cost-plus elements.

3.06 In the Republic of Slovenia, for example, our observations made in 1981 showed that only five inspectors (one for each enterprise) controlled road maintenance works for 4,700 km, including 105 km of high standard toll road, 902 km of other paved primary two-lane highways, and 3,693 km of regional highways. One inspector controlling between 500 to 1,000 kilometers

of highway may seem implausible, but in fact, the inspector actually supervised the work of between seven and fifteen crews. He participated in, and was familiar with, the work scheduling for the period; he knew the nature of the work to be accomplished at each location and what it would take to get the job done. He also knew when the crews were scheduled to accomplish each work activity included in the program and whether the activity was paid as a cost-plus or unit-price item. If the activity was cost-plus, he would spot check the crew for resource utilization as it was working. The end result of many unit-price items could be checked days later, to suit his workload and the crew locations within his area. Looking at the numbers involved and the method, it is not inconceivable that he could check 100 percent of all work production and make daily observations of resource use in all cost-plus operations, if he so desired. He could reduce or expand his "sample" based on the contractors' performance.

3.07 A key factor, of course, is that the inspector is not responsible for the direct supervision of the crews or for making detailed measurements of work. These are contractor responsibilities, and the inspector is free to carry out his primary functions of general quality assessment and spot checks on measurements.

3.08 The inspector and the chief of the enterprise must review and approve all daily work reports which form the basis for payment. Payment requests are submitted monthly by the contractor with full documentation. The inspector reviews the payment documents, referring to the spot checks of measurements, and notes on quality in his log. If serious discrepancies in measurement are detected, the entire payment request is discredited, and:

- payment is withheld;
- a lengthy process of field checking is carried out to recalculate payment; and
- control is tightened.

3.09 As a rule, the three steps described above occur infrequently because:

- inspectors are high-caliber highly paid people with considerable field experience (10 to 20 years; in 1981, in one republic the average experience was 22 years);
- as explained before, inspectors spend 60 percent of their time in the field applying contract management control procedures which are clearly defined and carried out; and
- contractors are careful not to overstate their invoices because the costs of being caught in a discrepancy are quite substantial.

3.10 Units of measure and measurement, for payment are not regarded as a problem. Measurement units differ between republics. For example, in one

republic, pothole patching and surface patching are measured in tons of asphalt mix. In another, they are measured in both square meters and tons, depending on the type of patching. But in both cases, investor and enterprise personnel are fully familiar with the applicable units and the procedures for measurement. The system is based on fairness and maturity on both sides of the contractual relationship. It appears to be working in Yugoslavia, but the practice may not be replicable elsewhere for some time to come.

3.11 Cost-Effectiveness and Mode of Procurement. Historical costs per kilometer for the maintenance of two-lane roads in the Republics of Bosnia-Herzegovina, Croatia and Slovenia for the period 1976-79 are presented in Table 6. The numbers presented include a mix of winter and summer routine maintenance activities, resurfacing, repair of structures and other minor categories. Slurry coats and chip sealings are not in general use.

3.12 Maintenance outlays, as Table 6 shows, vary widely among republics, with those in Slovenia being almost double those in Croatia. However, many important factors vary among the republics and it was impossible to assess, in the brief scope of this study, what part of the large difference in costs among the republics is due to differences in critical parameters such as climate, traffic and scale of the infrastructure, what part is due to differences in standards of maintenance, and what part is due to standards of efficiency. The latter are influenced by procurement practices, which vary among the republics.

3.13 Generally, contracts for periodic maintenance such as resurfacing are competitively tendered, with larger construction enterprises entering the competition, but routine maintenance contracts are normally negotiated with enterprises which have an assigned area of the road network. The possibility of tendering always exists, if a community is dissatisfied with the performance of a contractor, but in practice, not renewing a contract is a rarely exercised last resort; rather, budget and operational control procedures are exercised directly by the community to improve performance.

3.14 During negotiations, in the absence of price competition the community's interests are protected in two ways: (1) a competent professional staff, many of whom have extensive experience in contracting operations themselves, and (2) good cost information collected and maintained by the community, for both direct and indirect costs. Negotiations are said to be a serious give and take. The delegates of the community and their executive committee hold their professional staff accountable for road conditions, and there is little tolerance for increases once budgets (and contract amounts) are established.

3.15 The various republics employ elements of both the unit-price contract and the cost-plus contract in varying degrees depending upon local preferences. For example, in Croatia, a combination unit-price/cost-plus contract typically contains a very high percentage of unit-price items. In Slovenia, however, only 50 percent of the items in a typical contract are based on unit prices. The potential negative effect of cost-plus arrangements on incentives may be tempered in Yugoslavia to some degree because the

Table 6

Yugoslavia

Samples of Levels and Maintenance Funding
for Regional and Primary Highways
(US\$ per km) ^{1/}

Year	<u>Bosnia-Herzegovina</u> ^{2/}	<u>Republic of Croatia</u> ^{3/}	<u>Slovenia</u> ^{4/}
1976	2,338	1,548	2,850
1977	2,479	2,113	3,343
1978	4,556	2,846	4,744
1979	5,055	3,879	7,243
Comparative Percents to Slovenia in 1979	69.8%	53.5%	100%

1/ Dollars calculated using exchange rates of 18.2, 18.3, 19.2 dinars/US\$ respectively. The September 1980 exchange rate was approximately 27 dinars/US\$.

2/ For 1978 about 30 percent gravel roads; 1977, 40 percent gravel roads; 1978 and 1979, 14 and 12 percent respectively, due to decentralization of regional roads from republic level this explains the shaper rise in cost per kilometer.

3/ Percent gravel roads not determined.

4/ All paved roads included in calculation. 105 km of toll road not included.

enterprise is also contracting for other, often more profitable work, and this can provide incentive to carry out the maintenance work as expeditiously as possible, while the standards regarding road conditions, timeliness, and quality of what is expected from contractors, as well as budget controls, are well defined and closely enforced.

3.16 Proper definition and planning of work is, of course, in itself an important control on costs, and as noted above, the communities have accumulated over the years detailed knowledge of cost structures and determinants. Although open-market competition is not present, the enterprises' work is paid for on the basis of work performed, and well-defined cost parameters. This is a considerable improvement over other systems (force account or cost-plus contracts, for example) which often measure only the inputs.

Colombia

3.17 In contrast to the smoothly functioning system which has evolved over years of experience in Yugoslavia and Brazil, we now examine an initial attempt which was recently made to employ maintenance by contract in Colombia. This first experiment was not successful, and although its negative features were corrected, and the system improved considerably in its later development, it is appropriate to review some of those negative features, as examples of where contracting can encounter difficulties.

3.18 Four highway maintenance contracts were let in late 1977 by Ministerio de Obras Publicas y Transportes (MOPT), which is responsible for the construction and maintenance of highways in Colombia. The contracts were let for four years, over road lengths which averaged 100 km.

3.19 The following contract features eventually led to serious difficulties in this first experimental attempt at contract maintenance:

- (a) Comprehensive well-defined work programs were not developed. The MOPT transferred the responsibility for specific work identification and scheduling to the contractors. Also lacking were adequate penalties for noncompliance as well as close supervision of work progress and quality.
- (b) The contractors were required to collect tolls, which were their sole source of contract revenues. A formula was provided for escalation of the toll charges, based on daily traffic counts carried out by MOPT personnel. However, some of the original contract toll rates were based on unrealistic initial counts which led to toll collections below the anticipated necessary income. Toll charges were increased, but generally well below true price escalation levels.
- (c) Although unit rates were listed in the contract, and a method given for adjusting for price escalation, its application was left to MOPT's discretion. In practice

adjustments were not applied on a regular basis; such adjustments as were affected did not compensate adequately for inflationary rises in basic costs.

- (d) The contractors were required to provide and retain at the work site various items of equipment, including 30 ton-per-hour asphalt hot-mix plants, which significantly exceeded the requirements of the contract work quantities.
- (e) Since the contracts included both routine and periodic maintenance activities, and the contractors were free to identify and schedule work without supervision, the tendency was to schedule and perform the more profitable periodic maintenance activities such as seal coating or asphalt overlays, even without prior necessary strengthening or repair of existing pavement structures.

3.20 Other contract features which led to the early cancellation of the four initial contracts included clauses worded in terms which permitted contractors to delay the execution of work and thereby increase their holding of toll funds for their own advantage. In one case, the contractor carried out considerably less work than the toll money collected would have covered and, in another, the contractor collected tolls for six months without carrying out any work. All four of these first contracts ended in court cases.

3.21 Later Improvements. The second generation of maintenance contracts let in 1980 removed the toll collection feature, and instituted normal progress payments, drawing from tolls (collected by a third party) and MOPT budgets. Once again, periodic maintenance (mostly overlays) was included with routine maintenance in the same contract. An additional feature which was introduced was the planning and supervision of the work by an external consultant. This meant an increase in the overall cost of about 10%, but also the presence of sufficient numbers of field supervisors, which MOPT had not been able to provide directly before. Nine contracts were let in this second series, averaging 130 km each.

3.22 These contracts gave satisfactory results. The introduction of strong supervision, and the elimination of the collection of revenues from the contractors' responsibilities influenced this outcome. The flexibility of the contracting system was tested repeatedly, in the face of budgetary restrictions. Contractors were able to adjust reasonably well in times of fiscal stricture and continue doing the most urgent work. In contrast, force account units on other work were unable to cut down on salaries and wages of permanent personnel; consequently, cash was restricted for the purchase of supplies and materials, and this affected field performance of urgent work.

3.23 There is one minor area of rigidity in the contract system; this involves the supervisors supplied by consulting firms, who are engaged on a cost plus fixed fee basis over the period of the contract. If field work must be curtailed, their establishment is not adjusted down, to suit the reduced supervision duties. This rigidity has affected about 10% of the value of the work. Another problem, this time for the contractors, is the redeployment of equipment in case of enforced reductions of the work load. In particular,

this affects crushing and batching plants, which are not normally mobile. The contractors who have fared best in the face of the inevitable fluctuations of budget availability have been those who could sell or use asphaltic concrete elsewhere in the vicinity of their static plants.

3.24 An accurate cost comparison between contracts and force account has not yet been possible. The principal stumbling block is the lack of measurements of actual work put in place by force account units. Also, force account costs are not all gathered under the same budget heading; some, as for instance those relating to staff welfare payments, are absorbed by broader overhead accounts of the Ministry.

3.25 The nine contracts were let for periods of 36 months, and for average amounts of US\$11,000 (equivalent) per km and per year. Periodic maintenance and rehabilitation were major components of this work, and the main attraction for contractors. Routine maintenance was looked at as an unattractive contractual obligation. Nevertheless, the work was done, properly and profitably, by subcontracting the manual tasks to local groups along the contract length. The local groups were supervised by a "mobile" foreman, and worked in coordination with the contractor's own patching gang (8 men, one backhoe or loader, two tip trucks and auxiliary equipment).

3.26 The ease with which local groups were formed as subcontractors for the manual tasks of routine maintenance; a perceived opportunity to realize savings through the direct employment of those local gangs; and the opportunity to create permanent sources of employment in a larger scale, motivated MOPT to re-think the apportionment of maintenance tasks, on the basis of fostering "micro-enterprises" to carry out manual routine maintenance work. The new maintenance system, which was initiated in early 1985, is being structured in the following four tiers:

<u>Task</u>	<u>Responsibility</u>
(i) Periodic maintenance and rehabilitation	By established highways contractors; unit-rate contracts let through competitive bidding.
(ii) Mechanized routine maintenance tasks, and materials supply to micro-enterprises	MOPT, by force account
(iii) All manual tasks of routine maintenance (classified highway network)	Micro-enterprises; negotiated contracts
(iv) All manual tasks of routine maintenance for the rural road system under Rural Roads Authority (Fondo Nacional de Caminos Vecinales-FNCV)	Lengthmen

3.27 The system will rely upon the MOPT's own forces to carry out mechanized work, such as grading and major patching. Also, the micro-enterprise group will need to rely on MOPT supplies of, inter alia, base materials and asphalt mix for minor patching work. This is one major foreseeable snag in the system. If bureaucratic and budgetary constraints affect the flow of supplies and payments to the gangs, only part of the routine maintenance work will be accomplished, and the most visible and damaging problem, that of pot-holes and cracks in paved surfaces, may not be attended to properly. Also, while the informal groups of laborers worked well as subcontractors, a formalized system of MEs may fall prey to problems and constraints so far unforeseen. The system of employing major contractors who subcontract to local gangs could then become a useful, proven, fall-back position.

3.28 Nevertheless, the Colombian initiative to foster "micro-enterprises" (MEs) for routine maintenance merits special attention and, if the above possible constraints are overcome, may offer a long-term solution to the maintenance problem. The MEs are being formed especially for routine maintenance work. The formal organization is necessary to enable MOPT to enter into contracts, as required by Government regulations for public works. While contractors have been able to engage less-formally-organized gangs as subcontractors, regulations require Government to contract only with legal entities having duly appointed legal representatives. With the assistance of Mexican and Peruvian UNDP experts, a system to promote the formation of, and assistance to, the groups of men which will form the cooperatives has been established. The cooperative form of organization was chosen, as it offers considerable legal and taxation advantages in Colombia.

3.29 The new MEs (the first of which have started work in January, 1985) are being formed by groups of between 10 and 14 men. They are given a 50 km road length each, and put in charge of all manual maintenance operations (grass cutting, drainage cleaning, removal of small landslides, small patches, etc.). At this stage, when local competition has not developed, and the MEs and MOPT are going through the learning process, contracts are being let at the standard rate of 73,440 pesos of January 1985 per km/year (about US\$640) for paved roads and 54,560 pesos (US\$480) for gravelled roads. This should result in gross income for each ME member of between 1.5 and 2.5 times the legal minimum wage in Colombia (13,000 pesos per month, January 1985 figure). Contracts are for one year, renewable at MOPT's discretion. The MEs have to provide their own tools and transportation; if MOPT is called to assist with the purchase of tools, their value is deducted from the monthly payments to the ME.

3.30 MOPT is currently establishing 28 already-formed MEs in 8 pilot zones, covering the maintenance of 1500 km. During 1985, an additional 265 MEs will be established, over 1300 km in 7 additional zones. The final goal is to cover the whole 25,000 km under MOPT's direct maintenance responsibility.

3.31 The arrangements for the FNCV lengthmen follow similar ratios. Each man is entrusted with the manual tasks of maintaining 3 to 5 km, and paid 60,000 pesos/km/yr (about US\$520). The contracts are for one year, and are not renewable (i.e., after one year a new contract must be entered into).

Thus, the lengthmen are made to feel that they must perform satisfactorily if they are to deserve a new contract. There is always a plentiful supply of willing candidates to take over the lengthman's contract.

Argentina

3.32 Contractors in Argentina have for many years been engaged in periodic maintenance work and also, in a few cases, in routine maintenance of private (industrial estate) roads. Taking advantage of a new law requiring government agencies to reduce their work force, in 1979 Argentina's National Directorate of Highways (DNV) introduced a bold and imaginative scheme, which should have distributed routine maintenance work on the 47,000 km national highways network, 70% to contracts and 30% on force account -- over a period of 18 months. Complementary actions were taken to drastically reduce DNV's own personnel and equipment, and encourage ex-DNV engineers and technicians to embark on contract maintenance. The commitment of the DNV senior management at that time to contract maintenance was firm and enthusiastic.

3.33 The 70/30 apportionment of work was intended to:

- (i) give the maintenance Districts a continuing 'hands on' experience in the direct execution of maintenance, enabling their staff to better plan and cost maintenance operations under contract;
- (ii) introduce a competitive edge in maintenance work, providing a source of motivation for both contractors and DNV staff;
- (iii) retain in the DNV Districts the capacity to handle by force account minor maintenance activities which are difficult to manage by contract;
- (iv) enable DNV to retain the capability to take over the maintenance of roads whose contracts had failed for whatever reason;
- (v) retain in DNV a core of resources which could be applied to overcoming emergencies (in addition to the resources which contractors would have to make available for such emergencies); and
- (vi) provide a continuing training facility for road maintenance personnel.

3.34 These were the aims of a well-balanced system, which sought to obtain the maximum advantages of the market, while retaining a significant and motivated internal capability to carry part of the load, gauge market performance, counteract any tendencies towards collusion among contractors, and react to emergencies. Unfortunately, changes of management which brought about the waning of the commitment to complete the introduction of contract maintenance, coupled with the onset of economic difficulties from late 1982

onwards induced a departure from the system, and a retrenchment of maintenance operations as a whole. Expenditures in routine maintenance had fallen to 65% of their 1980 level (in constant terms) by 1983. Although DNV budget allocations improved somewhat in 1984, the contracting out of comprehensive routine maintenance almost disappeared. The last full routine maintenance contract expired in September 1984 and was not renewed. Table 7 illustrates the all-too-short experience in comprehensive routine maintenance by contract in Argentina. Having peaked at 35% of overall routine maintenance in 1981, it ebbed down to an estimated 17% in 1984.

3.35 The financial figures do not suggest that budget cuts per se would have been a compelling cause for reducing the contracting out of maintenance. In fact, they tend to confirm the view that the most significant cause of the reduction of contract maintenance from 1981 onwards was institutional. With the change of DNV management in 1981, and the resulting change of policy towards contracting of routine maintenance, the well-established DNV institutional machinery reacted in strength against the sapping of its direct participation in fieldwork.

3.36 Although DNV obtained satisfactory or better results with 90% of the contracts for routine maintenance in 1979-81, the system was not given a long enough trial to iron out initial problems. After a rapid conversion to contracts, a learning period of five to ten years should have been allowed, and this could have permitted the system to develop into a strong model of state and private organizations collaborating and sharing in the responsibility for the maintenance service. Assessment of this experience is nonetheless instructive:

- (i) Most contracts resulted in good performance against goals and specifications, in particular the contracts undertaken by local, experienced road building contractors who, however, were not experienced in maintenance. Most had estimated their bid prices on the basis of construction production rates, without taking into account the increased idle times of the maintenance operations. These contractors adjusted their prices upwards for the second round of bids, and were often the high bidder.
- (ii) Costs were particularly high for non-local firms, obliged to maintain a remote establishment, and their inability to share the equipment with other jobs caused losses through the poor utilization rates achieved in practice. Local firms specializing in roads construction, and capable of sharing equipment with other on-going jobs, fared best. Such was the case of a Catamarca contractor who was the last contractor on the job in September 1984.
- (iii) Many contractors were undercapitalized, their equipment was not in good shape, and they did not have spare capacity to deal with the more severe type of emergency.

Table 7

Argentina

DNV-Routine Maintenance Expenditures
(in US\$ million)

Routine maintenance carried out by:	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u> ^{4/}
Force Account	240.0	204.0	193.0	164.0	115.0	--
% of total	100.0	87	65	69	74	83
Contractors	0	30.0	102.0	44.0	41.0	--
% of total	0	13	35	31	26	17
Totals	240.0	234.0	295.0	238.0	156.0	--
(% of 1980 level)	--	(100)	(126)	(102)	(67)	--

Source: DNV. Deflators by World Bank.

1/ Only approximate relative figures available for 1984.

3.37 Should all contracts have been allowed a suitable time to settle in, it is possible that contractors could have become competent in maintenance in a few years, as well as competitive in pricing their bids. The above contractor from the province of Catamarca started work in maintenance by contract in 1979, and continued until his last contract, for 335 km, expired in September, 1984. According to DNV officers, this company's work was of a high standard, in compliance with contract requirements.

3.38 The Catamarca contractor is a local firm, specializing in highway construction (and now maintenance), and having industrial installations and other sources of work in the area. An approximate, and conservative comparison of the costs to the Government, by contract in Catamarca and by force account in the neighbouring Province of La Rioja is shown in Table 8. This simple comparison shows that force account was more expensive by about 10%.

3.39 The above single case, representing the longest standard contract under an experienced local firm, may not be conclusive evidence; but it provides a strong argument, by correlation with the experience in other countries, to justify a further attempt to establish the system of contracting out comprehensive routine maintenance for given lengths of road, when economic conditions improve. However, DNV has decided not to follow this path but rather, to contract out specific operations (grass cutting, drainage clearance, pothole patching) in an ad-hoc basis, possibly leading to the contracting-out of about 50% of the annual value of routine maintenance.

3.40 To some extent, this decision is due to the non-availability of a contract form custom-tailored to comprehensive routine maintenance operations, as opposed to the modified (but still rigid and complex) construction contract which was adopted. Another reason is the argument that small, ad-hoc contracts do not represent a long-term obligation, and can be set aside if budget conditions deteriorate. However, this reasoning does not take into account one of the prime advantages of comprehensive maintenance by contract: the shifting of the burden of management of day-to-day operations to the contractors, with a resulting reduction in the permanent departmental staff requirements and enhancement of the roles played by staff in management, and a resulting economy in overall cost.

Nigeria

3.41 Road maintenance has proven an intractable problem over much of the period spanning the development of the modern trunk road system in Nigeria. The Civil War ending in 1970 left an enormous backlog of maintenance and rehabilitation needs, and the rapid economic expansion stemming from the oil boom after 1973 brought an explosive rise in traffic. Not surprisingly, attention and resources were diverted to the construction and improvements program, and development of institutional capacities for maintenance lagged far behind ever increasing needs. Responsibility for maintenance of the federal highway network see-sawed between the Federal Ministry of Works (FMW) and the states as agents for the Federal Government, but neither has had the requisite capacity. An initial attempt in 1979 to tender maintenance for some 12,334 km of paved federal highways was aborted when the large variation in bid prices, reflecting uncertainties relative to the amount of work invol-

Table 8

Argentina

Comparison of Costs per km by
Contract and Force Account
(in \$Arg. of December 1984)

	<u>Per km/yr.</u>
(A) <u>Catamarca Contract</u> (335 km)	\$A 366,800
Contract price, after deducting periodic maintenance items such as wire fences, reconstruction of embankments, surface treatment (items A 9, 10, 12 and C 3, 4)	
<u>Deduct:</u> Value-added tax, 18% on (say) 40% of the Contractor's billings	(24,600)
<u>Deduct:</u> Corporate taxes, say 5% of billings, net of VAT	(17,100)
<u>Net cost</u> to Government	<u>325,100</u>
(B) <u>By Force Account, La Rioja</u> (1,292 km)	
Annual cost of maintenance for 1983	\$A 386,000
<u>Deduct:</u> National average of 17% of "09" contracts (minor periodic maintenance contracts let by Districts)	(65,688)
<u>Add:</u> General works insurance payable by contractors to cover the risks which the state underwrites directly for force account work (2% of expenditures, net of "09" contracts)	8,000
<u>Add:</u> Interest on capital used, assuming 10% opportunity cost, straight line depreciation for equipment, over 5 years. La Rioja equipment-use figures for 1983	32,500
<u>Total cost</u> to Government	<u>360,800</u>

Note: The percentage for value-added tax, corporate taxes, and interest on capital used are figures estimated in discussions with DNV staff.

ved, pointed to the need for more specific definition of work activities and quantities. Accordingly, in January 1980 a program intending ultimately to tender under unit-price contracts the entire federal network (except Lagos State) was initiated. Since the previous situation had been somewhat chaotic, it was still not possible for the Government to present contractors with a very clearly defined work program or performance standards.

3.42 The first lot of contracts ^{8/} were thus let with insufficient preparation, and resulted in abuse by the contractors. For instance, there was excessive attention paid to grass cutting, to the detriment of other activities, and contractors' invoices often exceeded the value of actual work carried out by very large amounts. Consultants were called in early in 1982, to assist in setting up an improved system for contracting and controlling maintenance. After almost one year of observations and preparation by the consultant, a new system was designed and put in place. It resulted in considerable improvements, but it was not tested and further developed over a long period, since the budgetary constraints of 1984/85 forced a retraction of activities, away from routine maintenance, and concentrating on periodic maintenance and emergency repair work, often let without tenders, to contractors who were based near the work areas and who had performed well in the past.

3.43 Contracts for maintenance peaked in 1982 and 1983, when 80 contracts were let, covering 13,000 km (or 45%) of the Federal highway network, at a cost of 84 million Naira (about US\$122 million) each year. Budget appropriations dropped to 60 million Naira (about US\$78 million) in 1984 and to an estimated 50 million Naira (about US\$55 million) in 1985. These figures are in current Naira; in real terms, the contraction has been considerably more severe.

3.44 The problems encountered in Nigeria have been similar to those described before, for the three South American countries, and can be summarized as:

- (i) difficulties in defining the extent of routine maintenance work, planning annual operations, costing them, and controlling the work; and
- (ii) the contractors' inclination to concentrate on the items with the most volume and highest price, particularly those of periodic maintenance.

3.45 The first type of problem arose from the lack of sufficient information on which to base performance parameters, and also the lack of suitable contractual documents with which to define the responsibilities of both parties to the contract, and monitor progress in the field. As mentioned previously, FMW senior staff became increasingly concerned with the problems of field supervision and general management of the maintenance contracts, and commissioned a firm of consultants to study and report on the system.

^{8/} By the end of 1980, 30 contracts covering about 6,600 km had been awarded.

3.46 The consultants reported in July 1982 that:

- (i) the deficiencies in contract documents were resulting in inaccurate billing of work done;
- (ii) there was a lack of capable, qualified supervision personnel in the field; contractors often had to decide on the program of work to be done;
- (iii) many contractors lacked experience in maintenance work, particularly of asphalt surfaces;
- (iv) the overlapping of contracts and State borders brought about a duplicity of supervisory functions and, at times, double billing, following separate State channels; and
- (v) considerable delays were experienced in the award of contracts, which resulted in problems in the contractors' planning of resource deployment.

3.47 There were additional flaws in the procurement system which resulted in awards to contractors who were not suitably qualified or had not provided the most competitive bid. The consultants concluded that FMW was incurring expenses considerably in excess of net contract obligations, and recommended that:

- (i) before the initiation of work on site, drawings should be prepared with an inventory of the condition of the roads; this information would also serve to plan the work and better define the contract documents;
- (ii) work on site should only proceed on written authority from the Engineer's representative;
- (iii) payment forms should be checked against the written work schedules;
- (iv) spot checks by senior staff should be introduced;
- (v) grass cutting (a lucrative activity to which much of the contractors' efforts had been directed) should be restricted to points where there was an acute visibility or drainage problem;
- (vi) the Engineer's representative should approve the materials to be used in carriageway repair; and
- (vii) the contract sectors should fall completely within the bounds of one state, the contracts should include a balance of routine and periodic maintenance operations, and larger contractors should be allowed to bid for more than one sector within a state.

3.48 These recommendations were applied from November 1982, and the consultants brought in a special team to help manage the system. However, although the size of the network under contract continued to expand, the supervising team was not augmented to suit, and the detailed preparatory work which was necessary for adequate management of the maintenance contracts lagged. This again resulted in the contractors tailoring their work to suit profit enhancement and, with the onset of budget cuts in 1984, a reduction in the execution of routine maintenance work.

3.49 Several important lessons are to be drawn from the initial experience in Nigeria. First is the importance of having a well-qualified team in the preparation and supervision of maintenance contracts, capable of:

- (i) planning the overall maintenance program;
- (ii) setting up individual contracts with due regard to the actual needs of specific road sections; and
- (iii) developing realistic work schedules for the contractors, taking full account of seasonal factors.

3.50 Second, the need to relentlessly pursue the execution of priority maintenance items, overcoming the tendency to neglect routine maintenance work, particularly in the face of funding constraints.

3.51 Third, the need to incorporate features which will ensure that the greatest possible benefit is derived from competitive market forces. In particular, this means setting up terms and conditions of contract which are fair and equitable, and permit the bidders a clear assessment of the risks involved in the maintenance work. With additional experience, it should be possible for FMW staff to define clearly the schedule of activities from year to year, and in terms which are simple to understand by the less sophisticated contractors. For example, the preparatory work originally devised was too elaborate, consisting of detailed drawings and the very extensive descriptions for individual items which are usual in quantity surveying practice. The task of carrying out these complex preparations for 18,000 km obviously proved beyond the capacity of the field crews, and this work lagged. A simplified system should help, following for example, the procedures-type specifications in special work item sheets which are used in Brazil.

Kenya

3.52 Kenya has also experienced severe difficulties in establishing an effective road maintenance capacity to meet growing traffic needs in recent years, despite large-scale foreign assistance from several sources. Acute shortages of experienced management and supervisory staff, fluctuations in available budgets (especially foreign exchange, with particularly adverse impacts on the availability of spare parts and fuel), cumbersome government procedures and a growing burden of redundant staffing (in a social context of severe unemployment problems) have all conspired to undermine the effectiveness and efficiency of government force account maintenance operations.

3.53 For several years after independence, the Roads Department employed small indigenous contractors to haul gravel for regravelling operations. In a later stage, several of those small firms evolved, with considerable assistance from the Roads Department, into contractors for the complete regravelling operation. By 1980/81 the small indigenous contractors satisfactorily produced approximately US\$5.2 million of regravelling works, which it is estimated, would represent only about half their potential capacity. Under the circumstances this was a notable accomplishment, accounting for approximately 80 percent of the entire regravelling operations done in Kenya that year. The Roads Department, due to various limitations, was able to accomplish during the same period only some US\$0.8 million, or about 20 percent of their estimated potential capacity (these figures are necessarily approximate and stem from rough estimates discussed with senior officers of the Roads Department).

3.54 It must be reiterated that this achievement by small contractors would not have been possible without the commitment to develop an indigenous construction industry, as well as considerable assistance from the Roads Department. Indigenous contractors in Kenya (as, indeed, in many other African countries) are generally not well developed and face a considerable array of problems, starting from nascent enterprise creation. The owners of these companies have very limited experience and no long-standing tradition of entrepreneurial vocation; management shortcomings are therefore considerable. There are, of course, a few exceptions but, by and large, the groups which are managing to survive and continue in business are doing so because:

- (a) their business span is small (often on an artisan scale) and therefore can be managed with their limited resources;
- (b) they are being paternally guided either by the Roads Department or by larger companies who subcontract their services; and/or
- (c) they are being subsidized by grants or loans from development authorities.

3.55 Thus, any undertaking of road maintenance through such contractors must be cautious, initially small in scale and encompassing only those activities which can easily be supervised (such as mowing, hauling, and regravelling), evolving only gradually over time into more ambitious undertakings. Supervision must be much more than a quality control and contract policing function: it must be concerned supervision, actively engaged in the development of the nascent enterprises. Ghana and the Central African Republic offer similar examples, which we review in the following sections.

Ghana

3.56 Over the past 10 years, a group of domestic road maintenance contractors has been assisted to develop, with support from the World Bank-financed Second and Third Highway Projects. Further assistance has been included in the Fourth Highways Project. This program was launched to create a

domestic capability to engage competitively in work which was not attractive to international bidders, particularly periodic maintenance operations. The program started with 40 firms, and 25 are still in operation today, having survived periods of extreme economic difficulty in the country.

3.57 Contract work has proven to be a strong driving force for achieving results in maintenance work. Contractors have particularly concentrated on regravelling work, and their participation in overall work achieved under this heading has been consistently increasing, as shown by following figures:

Participation of Contractors in
Regravelling Operations (in km)

	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>
. Total needs	1,600	1,600	1,600	1,600
. Total achieved, by contract and force account	652	778	672	650
. Of which: by contractors	418	517	627	650
. Representing (% of total achieved)	(64)	(66)	(93)	(100)

3.58 These figures refer to regravelling only. The participation of domestic contractors in resealing work has also been increasing, and in 1985 it is estimated they carried out 80% of all work, or about 144 km; the GHA have carried out 36 km of resealing by force account. Routine maintenance by contract is also beginning to spread: in 1985, contracts for 245 km were let in the Volta Region while, in the Western Region, two timber companies were given contracts to maintain public highways within their area of influence. Single-man contractors (lengthmen) are also being established, in the Volta and Central Regions.

3.59 One important lesson emerges from the program to strengthen the domestic contractors: the numbers may have been too ambitious at the start. 40 firms is a large number indeed, and would have caused a dilution of the technical and financial assistance resources. This compounded the effect of the difficult economic period which Ghana has been going through, with the attendant delays in payments for Government work, to result in a very high "casualty" rate (15 out of 40 firms, or almost 40%). The rate is high, given that the contractors had some experience ab initio, even though their equipment holdings were inadequate. When starting with people who have no experience as contractors, and must learn the trade from the very basic principles, a higher failure rate of individual firms can be expected. In such a case in the Central African Republic, for example, the rate is expected to be of about 50%.

3.60 The above is the longest experiment carried out in Ghana to introduce competitive practices in maintenance, but by no means the only one. The Ghana Highway Authority (GHA) is currently working on other options for improving the cost efficiency of maintenance, and developing innovative vari-

ations to force account and contracted operations. Two of these are worthy of note: the mobile maintenance unit and the single man contractors.

3.61 The Mobile Maintenance Unit (MMU). Given the shortcomings of the GHA force account regional crews, largely resulting from the snags and difficulties which usually afflict government's own forces, the GHA, with assistance from the Japanese Government, set up an experimental MMU. To protect it from interference at regional and local level, and from the other trappings of bureaucracy, the unit was given a high degree of autonomy. This included autonomy for management, a direct allocation of funds, and the availability of the MMU's own support services (such as equipment maintenance and accounting). In fact, it has been made to operate as an independent contracting unit, performing against pre-established performance parameters.

3.62 Individual performance has also been rewarded, by the provision of incentives to the workers, such as camp facilities and meals or meal allowances. As a result, worker discipline is high. These features, plus the availability of a modern, well maintained equipment fleet have made the MMU a very successful operation.

3.63 Although the MMU experience may not be replicable in a large scale for force account operations working under "normal" bureaucratic constraints, it is nevertheless significant as an indication of how force account units could be made more competitive, for instance, to participate in bids with contractors, to provide a challenge and control in the pricing of work. The Ghana MMU (soon to be joined by a second one) has not been used in this capacity yet.

3.64 The Single Man Contractors (SMCs). The SMCs are an interesting development of the lengthman concept, based on the introduction of piece work for manual routine maintenance operations. This experiment was started in the second half of 1984 on a pilot basis, in the district of Winneba. It is planned to give each of 120 SMCs a 5 km length on which they will carry out grass cutting and drainage clearance by hand; the GHA would retain a force of 44 men to carry out patching, grading, etc. The labor force will thus be of 164, as opposed to the previous approved complement of 250.

3.65 The planning of the work to be done is carried out by overseers, who discuss it with each SMC and with their own management. The same overseers are in charge of measuring the work for payment. Payment is effected on a piecework basis, at a predetermined value per unit of work performed (or, in fact, as a unit rate contract).

3.66 At first, the SMCs did not understand the system, and their earnings were below the official wages set by the Government for laborers. However, when the SMCs realized the advantages they would derive from a higher productivity, their average earnings rose steadily and, by March 1985, one SMC was earning as much as 7.5 times the prevailing wage for laborers. Production rates more than doubled: the average monthly production of 5,300 m² per man of grass cutting observed in October 1984 rose to 11,500 m² by March 1985.

3.67 GHA personnel have been encouraged to join the SMC forces, and the District is close to fulfilling its goal of 120 SMCs in operation. The quality of the work being carried out by the SMCs is reported to be excellent. However, it should be noted that, as with any piecework operation, close supervision and accurate measurement are essential. Also, a steady flow of cash for a timely reward of the SMCs efforts. There is no greater dampener of productivity than a late or incomplete reward for a man's efforts.

3.68 The GHA management expects that, as a result of resorting to contract maintenance (by established private contractors, by SMCs, and by private companies whose main activity is not contracting, such as mining and timber companies) it will be able to reduce its total staffing by about 47% (from 5980 to 3200), with the greatest reduction in laborers and operators (48%, from 5440 to 2800). The latter should find opportunities for work with private contractors or as SMCs.

Central African Republic (CAR)

3.69 The C.A.R. is another country which has been experiencing considerable difficulty in establishing a long-term highway maintenance facility. Beset by resource shortages and institutional problems, maintenance has been undertaken only intermittently, and the road network had deteriorated accordingly. Actions are under way in the country at present, seeking to establish small contractors for routine maintenance. Under the World Bank-financed Fourth Highways Project, a consultant carried out a study of the development of "petty" contractors (petits et moyens entrepreneurs); the study concluded that it was feasible to establish small contractors in routine maintenance. It also proposed a series of steps to develop those contractors, starting from basic training. The consultants' report was presented in early 1984, and work started on the implementation of the proposed plan later the same year.

3.70 After the selection of the small entrepreneurs, they are given classroom training, followed by a 4-month practical training course (during which they run their own section of road, under the close supervision of, and with technical assistance from, the project consultants). The cycle will be repeated in a second phase, this time with 6 months practical training. Finally, the entrepreneurs will be tested, given "reinforcement" courses, and given a first 12-month experimental contract, on a schedule of fees, and with full responsibility for managing their resources. The courses for contractors are being paralleled by a training course for the Ministry of Public Works (MTP) staff who will be in charge of planning, contracting out, and supervising the work of the small contractors.

3.71 The consultants have estimated that the whole process should take 27 months, from the selection of candidates to the letting of the first contracts. During Phase 1 (ongoing), the candidates are treated as temporary employees of MTP, and are paid bursary allowances, plus a bonus if the productivity of the team they direct is seen to improve. During the second stage, they will continue being remunerated on a bursary basis, but the allowances will be supplemented by a share of the nominal profits realized by the team under each trainee's direction. Finally, after being tested and qua-

lified, they will be given full responsibility for their first experimental contract, under control and with the technical assistance of the Consultants

3.72 The small enterprises will operate only on the trunk road network, carrying out manual routine maintenance work; materials will be distributed by MTP. The system is not unlike that of the "micro-enterprises" which have begun work in Colombia.

3.73 The French and German bilateral agencies are also assisting in experiments to establish lengthmen for road maintenance, within a 290 km stretch of road in northwestern CAR. One full-time technical adviser is dedicated to training the lengthmen and providing them with technical assistance. Each man is given responsibility over 3 km of road, and paid 15,000 Fr. CFA per month (about US\$31 equivalent) during the 9 months of the dry period, when work can be done in the roads. This is equivalent to US\$93 per km-yr. Over the two years that the system has been in operation, results are reported to have been excellent.

3.74 The latter experiment however, is being carried out in laboratory conditions, as most of the funding is being provided as a bilateral grants and the system is not being put to the most stringent test, that of adequacy and continuity of cash flows. Cash flows, the regularity with which contracts are renewed, and the ability of the market to replace those petty contractors who abandon the tasks, will be the real tests of the system, once external props are removed. The first two conditioning circumstances highlight the need for parallel action, creating within Government the mechanisms that will ensure continuity of the contractual and financial arrangements that will permit small entrepreneurs with precarious means to survive and maybe even prosper, forming the basis of a wide-reaching domestic construction industry. At the same time, the training of new entrepreneurs must continue, at least until such time when the pool of contractors has grown sufficiently to start generating offshoots and successors of the older-established firms.

3.75 The system of small enterprises being developed under the Fourth Highway Project will have a first (pilot) stage; starting with 18 candidates in its Phase 1, it is expected that 8 to 10 will reach the certification phase, and 4 others will have received a sufficient technical training to be employed by Public Works as team leaders for manual routine maintenance by force account. In the second stage, 12 candidates will be selected, from which it is expected that 6 will "graduate." Each will be given an average of 60 km to maintain. The consultants estimated that the establishment of the 8 to 10 entrepreneurs in the first pilot stage would require 34 man-months of expatriate advisors. This would represent a cost of the equivalent of about US\$350,000 per enterprise in expatriate costs alone, or about \$6,000 per km of road that will benefit. In terms of the added life that regular maintenance will contribute, this should be a reasonable price to pay. Ideally, the training of MTP staff should include a feature for "training trainers", in a way that it will become self-sustaining in future, i.e., without a continuing foreign input.

The United Kingdom

3.76 Although we have refrained so far from describing in detail many interesting experiences of contract maintenance in developed countries (e.g., in the Netherlands and the United States), the U.K. experience must be noted here, as it offers an example of the type of national policy which can open up the highway maintenance activity to the forces of the market at large. In a recent paper, Cox ^{9/} describes the development of these new policies.

3.77 Whereas in the past local governments (counties and districts) carried out maintenance work by force account ("direct labour"), as a total monopoly of this activity, today the force account units in local governments are forced to compete in open bidding with private enterprises, and to survive on the basis of their productivity and ingenuity. The change of policy has had many salutary effects in the local councils. In the first place, they are now obliged to predetermine needs: they have to plan ahead carefully, to establish the annual volume of work which is to be put out to bids. Since the tendering and contracting process commits public moneys almost irreversibly, planners are compelled to be far more rigorous in their work than when planning the operations of force account units (which, more often than not, are operated on an ad-hoc basis, with resource allocations which carry on, from year to year, without the benefit of a careful scrutiny). In fact, planning and management in general become the exacting activities that they should always be, regardless of whether the work is carried out by contract or force account.

3.78 In the second place, the planners and managers, free of many of the pressures and distractions of day-to-day running of a force account operation, can take a wider view of maintenance, and dedicate themselves to their essential functions. Thirdly, the force account units (which are now identified as Direct Labor Organizations - DLOs) have been forced to adopt the operating systems of private enterprises, particularly with respect to monitoring the use of resources: accurate cost accounting has been introduced, and the results are fed back into the estimating process, to enable to DLOS to tender profitably for the following jobs.

3.79 The DLOs are also required to produce a minimum return on the capital (5% pa). If this minimum return is not achieved, Government can opt to close down the DLO. Partly as a result of this challenge, work forces and capital assets have been trimmed down to efficient levels, and productivities have increased considerably. This negative incentive to productivity ("produce more or lose your source of employment") is coupled with positive incentives for the labor force, in the form of bonuses which distribute part of the profits achieved by the DLO (in excess of the minimum return on capital). The balance of the DLO profit is handled in different ways by the various Councils: some reinvest, buying new equipment, or increasing the scope of services offered; others absorb the surplus in the common fund; yet others compromise between those two extremes. None has yet introduced financial incentives for management.

^{9/} Brian E. Cox, Evaluation of the U.K. System of Incentives for Efficiency in Road Maintenance Organizations, and Possible Lessons for Developing Countries. Report to the World Bank Transportation Department.

3.80 The British competitive system is mainly used in clearly quantifiable discrete operations, such as overlays, surface treatments, structural repair. Routine maintenance items are being contracted out, but only when they can be identified and measured as discrete works: for example, grass cutting, or patching of a pre-delineated and measured road length. The system has not yet been extended to encompass all the work involved in comprehensive routine maintenance contracts. However, financial ceilings applicable to the size of work which can be done by force account are being lowered, to enforce an increasing measure of competition, and this may lead eventually to comprehensive contracts of routine maintenance.

IV. CONCLUSIONS AND RECOMMENDATIONS

4.01 This brief review has shown that the use of contractors for routine as well as periodic road maintenance is gaining increasing use in several countries. Motives have varied: some countries have turned to contractors as a last resort when continuing efforts to build up government institutions over many years have failed to produce efficacious results; in other cases, the government and road authorities have sought improvements in efficiency so that increasingly hard-pressed highway budgets would stretch further; and in still other cases, road authorities have reluctantly turned to contractors when general restrictions on hiring of government personnel prevented further buildup of force account establishment to meet growing maintenance needs. Different countries, depending on their individual circumstances, have also approached the use of contractors in different ways: some have employed cost-plus contractors as hardly more than suppliers of men and equipment in an indirect extension of force account operations; others have taken maximum advantage of the management capabilities and incentives of unit-price contractors. Some countries have moved with speed to thrust the burden of entire networks on contractors, while others have taken years to gradually expand the role of contractors from minor beginnings to a still moderate role today. What general conclusions can be drawn at this stage?

General Conclusions

4.02 The Efficacy of Contract Management. With rare exceptions, contract maintenance has proven to be a workable undertaking in countries at diverse levels of development and with diverse forms of social and economic organization. With relative freedom from entangling "red tape" and the ability to pay higher salaries to attract, retain, and motivate staff, contractors have in some cases, e.g., Nigeria, succeeded in getting maintenance done where all other approaches had failed. Where sufficient profit incentives exist, contractors are normally attracted to maintenance opportunities, even in remote areas; while larger firms tend to prefer larger contracts including periodic maintenance, in many instances small firms have been formed specifically to undertake routine maintenance. Contractors are also commonly obligated to make their men and equipment available to the road authority in the event of an emergency.

4.03 It must be recognized, however, that the introduction of any new system, especially quickly and on a large scale, is risky. The earlier

experience in Colombia and Nigeria illustrates some of the problems which can be encountered in introducing contract maintenance with inadequate planning and preparation. While the overall burden of responsibilities on the road authority is normally reduced by the contractors, the nature of the government's responsibilities changes sharply, and there is increased need for contract management skills. Careful planning and the introduction of contracts on a small trial basis initially can therefore reduce risks, permitting the capabilities of government and contractors alike to develop before thrusting too heavy a burden on a new system.

4.04 The commitment of government to the introduction of the new system is essential: on the one hand, contractors have to adapt to a type of work (particularly routine maintenance) which they have not traditionally carried out. On the other, a monopoly is being broken, and the resistance of those who run it (and will be faced by new challenges and by more exacting management demands, as well as by the loss of direct command over men and machines) must be overcome, at the same time as they and their staff accept and prepare for new roles, as planners and supervisors of contract work.

4.05 The Efficiency of Contract Maintenance. While the cost (or more correctly, prices) of contract maintenance can be taken from records of contract administration, and the direct costs of contract supervision by the government could be assessed, quantitative comparisons with the comparable costs of similar operations by government forces are not generally available. Few road authorities in developing countries have management systems which can produce reliable performance and cost information with which to plan and control operations. Systematic recording of the amount of work achieved (as distinct from the amount of resources consumed) is not generally done, and both the amount of diversion to other activities and the amount of idle time are likely to be underreported. Moreover, the economic cost of interest on government investment in plant and equipment is often overlooked, since it is not perceived as a financial cost. Regardless of the prospect of contracting maintenance, there is a great need for improved work planning, performance monitoring and more effective cost accounting in force account maintenance operations, but the prospective increased use of contractors to achieve improvements in cost-effectiveness in the future places particular importance on development of comparable cost information.

4.06 However, certain inferences can reasonably be drawn on the basis of partial information which is already at hand. Unit-price contracts clearly provide contractors with strong incentives for efficiency, and initial cost results from Brazil, Argentina and Kenya (and also the United States) suggest that contractors can perform maintenance at substantially reduced costs. The administrative costs to the government in contract management, quality control, measurement, and certification is normally substantially less than in administration of force account works, although the nature of the administrative burden is different and may require enhancement of contract management staff. In every case where contract maintenance has been used on a large scale continuing over time, government has been able to effect a substantial reduction of its own establishment. Yugoslavia, with more than 20 years ex-

perience, provides an example of a mature contract maintenance system where as few as five inspectors and one director (in Slovenia) supervise maintenance for a high standard road network of 4,700 km, with only limited support from the general administration; the entire road authority (encompassing planning, construction, maintenance, operations and safety) consists of only 185 persons - a fraction of that typical of most road authorities world-wide.

4.07 Those who are familiar with the difficulties in attaining efficient levels of operation in too many road maintenance directorates, not only in developing countries, will require little evidence to convince them that the contractors can perform maintenance at lower costs. However, many may question whether much of the potential cost savings would revert to the public. The best safeguard of the public interest is lively, open and honest competition; where this is assured, large cost savings are likely to be realized. Since the end of the great road building boom of the post World War II period is at hand in most countries, it is plausible to hope that some of the civil engineering capacities and skills thus developed, which must now seek new outlets, will find their way into maintenance activities, thus enhancing competition and working in the public interest.

4.08 However, it must be recognized that the twin dangers of monopolization and corruption are ever present. While government force account operations are, of course, not immune to corruption, many may argue that government procedures, while encumbering efficiency, do reduce the amount of corruption--while others might retort that a small element of corruption would be a small price to pay for vastly enhanced efficiency! Retaining at least a nuclear force account operation, as was planned originally in Argentina, should help greatly to reduce the danger of monopolistic exploitation and provide a useful source of comparative costs.

4.09 Contractors' Lobbying of Public Support for Maintenance. Inadequate government budgets for road maintenance are a widespread phenomenon, even in high income countries. Certainly contractors' associations have been active participants in the broad grouping of interests which have formed the lobbies for road construction that have been so potent in recent decades. Where contractors become an established force in maintenance activities, it may be conjectured that their interests will prompt them to lobby for increased budgets for road maintenance, enhancing the much weaker (or non-existent) lobbies presently promoting such expenditure.

Under What Circumstances Should Contract Maintenance Be Considered?

4.10 The possibility of contracting some part or all of routine as well as periodic maintenance operations should be considered by every road authority. Any of the following circumstances should particularly prompt consideration of contracting:

- (a) where services of short-term, small-scale or specialised nature are required, particularly where established capacities for these services already exist with contractors or other suppliers;

- (b) where expanding maintenance needs cannot be met by existing government establishment;
- (c) where there is known to be a serious problem of idle equipment, staff redundancy, or other major inefficiencies with existing force account operations;
- (d) where efforts to build up institutional capabilities of government have met with continuing difficulties due to the inability to attract and retain adequate numbers of competent managerial or technical staff.

4.11. Circumstances which will make the use of contractors more problematic include:

- (a) lack of (or weakness in) established domestic contracting industry; and/or
- (b) lack of (or weakness in) government capabilities to manage contracts.

4.12 Those countries with limited or nonexistent domestic contracting industries also typically have very limited institutional capacities for the execution of works by force account. In these cases, the task of developing the necessary institutional capacities will be long and difficult no matter which course is pursued. However, where development of a domestic contracting industry is at all a feasible proposition, it should be noted that most characteristics of routine road maintenance activities--small scale, technical simplicity, low capital requirements and a relatively stable demand over time--make them particularly well suited as a beginning activity for the nascent contractor. The primary counter consideration is the dispersed nature of the work, which, as compared with the types of work traditionally contracted, increases the difficulties and costs of contract supervision. However, it is not clear that the need for, and difficulties of supervision will be less when the same maintenance works are performed by government forces, although the costs are usually less obvious.

4.13 In those countries where the development of governmental capacities for road maintenance has proven to be difficult because of problems in attracting, retaining and motivating staff, or because of other governmental constraints, the strategy of limiting the burden on government as much as possible, concentrating development of its capacities on the management of contracts, and fostering the development of the domestic contracting industry is an option which merits serious consideration.

How Should Contract Maintenance Be Introduced?

4.14 The character and extent of contracting for maintenance, and the pace at which it is introduced, will depend on local circumstances. Where there is a well established domestic contracting industry, combined with an established capacity of government to supervise contractors, extension of contracting services to maintenance activities should present few difficul-

ties and can be accomplished very quickly, although the need to ease dislocation of government workers may slow the process. Where the aim is to promote the development of small contractors, as in the Kenyan case, or the government's capacity to manage contracts is limited, a more cautious approach, perhaps modelled on the Brazilian pilot projects with unit-price or schedule of rates contracts, is advisable.

4.15 Two principles should guide selection of activities to be contracted: complementarity of existing capacities of government and contractors, and ease of administration. Periodic maintenance--regravelling and resealing--has been contracted so extensively largely because of the ease with which it can be administered. Routine maintenance, whether by force account or contractor, is more difficult to administer primarily because it is comprised of many small scale, widely dispersed activities.

4.16 An essential ingredient of any cost-effective routine maintenance program is careful planning, scheduling and control. It is an advantage of contracting that it promotes, indeed requires, more careful planning and control of such activities. All of the successful contracting schemes have involved close coordination between the government and contractor in defining the work to be done and planning the work program. Thorough orientation of contractors prior to tendering promotes understanding of the tasks to be done, reduces perceived risks and risk premia included in tender prices.

4.17 The majority of work should be undertaken under unit-price type contracts. A small element, typically not exceeding 10-15 percent of routine maintenance, may be done under cost-plus arrangements to simplify administration of items which are difficult to measure, and also to add management flexibility (as, for example, for emergency operations). Other types of contract which apportion a greater share of risks to the government, e.g., cost-plus-incentive-fee or cost-plus-incentive-or-penalty ("target price") may be considered in some cases, particularly where uncertainty perceived by contractors may be large at the initiation of activities for which they have no prior experience on which to base their productivity and cost estimates.

4.18 Simplicity and maximum incentives are desirable features of the contract, and in general unit-price contracts have proved well suited to maintenance activities. However, standard forms based on construction activities are often unsuitable, and contractual instruments should be drawn specifically to fit the needs of routine maintenance. Many governments may wish to consider, at least initially, the use of a management services contract in order to develop management systems and contract instruments.