TABLE OF CONTENTS

Evaluation of the Demonstration Project on Road Maintenance, Costa Rica

Executive Summary

EXECUTIVE SUMMARY

A. Findings and Conclusions

1. The Demonstration Project on Road Maintenance has been very successful in showing that road conservation by private sector contractors is a feasible and effective means of getting this work done. Physical results have been good and public reaction highly favorable. The procedures used in formulating, contracting and prosecuting the program were generally well-conceived and have been carried out with professional skill. Working relationships have been satisfactory or better, among the administrative participants, with the contractors, and with local governments. The accomplishments and the absence of serious problems indicate that the measures designed and utilized to carry out the project were well-focused on its goal, and effective in working toward it.

2. Maintenance of public roads is usually done by public agencies, but contracting of some type of work is common. It is sometimes imperative, when special skills or equipment are needed, or there is a large backlog of work.

3. The road system of Costa Rica is fairly well-developed, with a national network (paved and some unpaved) under the jurisdiction of the Ministry of Public Works and Transport (MOPT) and a larger system of local roads

(with limited amounts of pavement) under cantonal governments. Road conditions are deteriorating in most areas. A 1979 study said that 66% of the national system should be rated as "bad" or "very bad." Visual inspection of about 900 km confirms this, leading to the conclusion that the present maintenance effort is not adequate.

4. Among the efforts to improve road conditions, the World Bank financed a maintenance management study, carried out in 1983-84. This provided all the normal procedures for organizing and executing maintenance, but did not have the anticipated results.

   By agreement between the World Bank and MOPT, the Fifth Highway Project was modified in late 1983 to try a limited program of routine and periodic maintenance by contract. This was to be funded by Costa Rica but problems developed, and in August, 1984, USAID agreed to finance the program with local funds, equivalent to about US $ 5.0 million.

5. Called the "Demonstration Project on Road Maintenance", the program was organized in November-December of 1984, to be administered by a local road development association, with close participation by MOPT and AID. Progress was rapid and bids were received on the last of three sub-projects in mid-April, 1985. Established

as a two-year program, by the middle of the second year a large pavement recycling sub-project had been completed, and regular maintenance by contractor forces continued in the other two. By then approximately 90% of total funds had been put to use.

6. The Demonstration Project called for:

   (a) Recycling on 26 km of four-lane pavement near the capital.

   (b) Two years of routine maintenance on 100 km of road in the central part of the country, mostly paved.

   (c) Two years of maintenance, with rehabilitation, on 90 km of road in a southern region of the country, mostly unpaved.

7. The administrator of the project is the Asociacion de Carreteras y Caminos de Costa Rica (ACCCR). It is a non-profit, non-political service organization founded in 1952, which promotes road programs but also participates in scholarship programs and road meetings, conferences and seminars, including those of the International Road Federation. Its official status as administrator of work on public roads was established in October, 1984 in a memorandum of understanding (MOU) with MOPT, also signed by the AID representative. The MOU includes provision for outside audit of funds, and establishes a 'Construction Committee', with members

from the three participating entities, to take part in program management.

8. The Demonstration Project has been successful. It is very clear that maintenance activities can be contracted, and can be executed rapidly in this way. Dependable funding is necessary.

9. The work programs of the maintenance sub-projects were made up using data from the prior maintenance management study as a guide. This caused problems because the inventory format and workload factors were too general for application to specific roads. The factors were also found to be too low. Worse, the inventories had not identified a great quantity of rehabilitation work necessary to get to a 'standard' condition for normal maintenance. The scope(Kilometraje)of both sub-projects had to be scaled back, and large amounts of cost-plus work were required of the contractors. In routine activities, contractor productivity was higher than had been expected, compensating in part for the under-estimation of work quantities.

   There were no similar problems with the recycling sub-project.

10. The administration of the project has been excellent; the ACCCR, acting through its board of directors and an engineer retained as project manager, has pursued a

rapid-paced, multiple program, with good results and few problems. There are some advantages to this 'substitute owner' arrangement, and it should work elsewhere, at least short-term, provided there is a suitable and willing entity.

11. The bidding and contracting procedures used in the project were simplified and accelerated. Each of the two maintenance sub-projects was moved from advertising for bids to notice to proceed (to the contractor) in less than 45 days. Publication of all steps was ample and no challenges surfaced, nor were there major problems in controlling the work. The successful short-cutting can probably be credited to the contracting experience of ACCCR members and staff; it is not likely that the same degree of simplification can be transferred to any government agency, with its greater need for wide public view and multiple certifications.

12. The engineering and management control of the maintenance sub-projects was certainly adequate, and more than would be necessary on a long-term basis, or for any program which was not new to all parties. As it turned out, this generous provision of engineering control was put to use because of unexpected rehabilitation needs.

13. The project funds were distributed to three geographic areas and to several kinds of work, including deferred

maintenance and betterments not contemplated orginally. The same freedom to shift funds would not be practical in a government agency and is, in fact, one of the causes of problems in force account agencies.

Concerning funds distributed by budget categories, the percentage allocated for engineering rose as the program advanced, and seemed to be quite high. However, this is partly due to the close engineering control and inspection provided, considered necessary in an experimental program.

Regarding the kinds of projects, funds distributed to the recycling were about 10% greater than for either of the regular maintenance demonstrations. This was justified by the potentially wide application of the recycling, and the need for a substantial size project to attract bidders.

14. Well-planned maintenance contracts will result in efficient programs, at minimum costs. Government agencies in developing countries do not do as well, not because their planning is inherently poorer, but because they cannot marshal the resources to carry out programs. Lack of effective funding holds up repair parts and other purchases, and schedules break down. In maintenance by contract, a crucial advantage is that

qualified contractors can put men, equipment and materials together on dependable schedules.

Well-planned contract work can be of great benefit, but the concept of augmenting this benefit by trying to set optimum levels of maintenance in the contracts is probably not practical.

15. The project has achieved some permanent and valuable effects, in addition to the immediate improvement in road conditions and the related benefits to users. Prompt, normal maintenance and the potentials of pavement recycling have been demonstrated. The MOPT has shown a new interest in maintenance alternatives, local governments have been energized, and the general public is now better informed regarding maintenance.

16. In the contonal governments, local capacities have been enhanced by the project. They have gained in technical knowledge, management skills and useful political experience. It is expected that these gains will be utilized as an influence toward better local road maintenance.

B. Evaluation Methodology

The process used to assess the Demonstration Project, and road maintenance in Costa Rica, was direct and simple. Reports and documents of the project were generously supplied by the Project Manager. Other

library material, of the prior maintenance management study and related subjects, historical and technical, was freely offered by the engineering consultants. This was all reviewed carefully to gain an understanding of prior conditions and development of the project, events in the course of its progress, and its status. Primary data sources are indicated in Attachment No. 1.

Candid talks were held with all participants in the project, including officials of the MOPT Maintenance Division. Visits were made to all three sub-projects. In addition, unaccompanied inspections were made on main routes to both the eastern and western coasts and into other regions of the country, over highways not covered in the project visits.

This reading and inspection provided a close view of project circumstances and road conditions, as well as contractor and MOPT operations. Reading the file material disclosed that there was very little firm data for more detailed assessments, of costs or savings, comparative productivity or other factors of interest.

C. Development Impact

1. All facets of transport improvement affect the economic and social development of the areas in which they occur. Changes in the status of road service have more detailed impacts than those of say, airports or rail-

roads, which are confined to geographic points or corridors, and depend on roads for extension of their effects to the places where people live and work.

The original construction of roads into new areas has fundamental impacts. It increases the value of adjacent land, raising its market price but also reflecting a greater utility of the land, for higher-type agriculture and other economic uses. The new road changes the lives of people who live near it, and attracts more people to live there, because it permits new enterprise and gives access to whole fields of social interactions.

2. The improvement of existing roads to higher standards, wider, straighter, from earth to gravel or from gravel to paved, brings marginal increases in these same basic factors of land use and social development. More easily measured are the so-called direct benefits of the road improvements; shorter distance or greater reliability of transport, more traffic capacity, higher travel speeds. Most of these benefits are quantified in lower vehicle operating costs, those of vehicle life, repair, fuel and tire costs and, usually, value of occupant's time.

3. Adequate maintenance of an existing road cannot produce further direct and indirect benefits. Maintenance is

intended to prevent the loss or serious decrease of the benefits which were gained by the road improvement. It is accepted that even with good maintenance there will be a gradual increase in VOC as surfaces wear and decay, and as natural changes take place. Regular maintenance is obviously needed to avoid rapid increases in VOC and to minimize the threats to the basic use of the road, as in washouts, mudholes, slides, bridge failures, and so on.

4. In Coto Brus, the sub-project area in southern Costa Rica, many sections of the most useful local roads had reached a condition where fundamental benefits were in some jeopardy, and VOC levels were very high. The situation had existed for years, in a region which produces a large part of the export-grade coffee of Costa Rica. Land had been converted over the years from forest and grazing uses to coffee planting, giving a product of much higher economic value, but also perishable.

In these circumstances, the rehabilitation of the local roads of the project was equivalent to raising the standards of those roads. A year earlier, and in the first phases of the Demonstration Project, churned-mud sections and undrained water crossings made the shipment of coffee precarious during the frequent rainy

periods, and significant losses occurred. Other movements were interrupted in the same way, reducing travel related to medical needs, schooling and community affairs. Therefore the rehabilitation, in conjunction with some minor betterment, had a profound development impact. The poor road conditions existing before had become permanent, there was no plan to correct them, and the Demonstration Project had the impact value of building better roads. The Engineers' Annual Report for 1985 says, "--A rehabilitation of 33% of the local road network--generated economic benefits in a zone of influence which represents 80% of the coffee zone--." The same report estimates that an expenditure of 35 million Costa Rican Colones (around US $ 675,000) on the restoration of 97 km of road produced benefits of ₡ 209 million in the first year, through increased coffee harvests, reduction of spoilage caused by delays, and lower VOC on improved travelways. The greater part (₡ 140 million) was attributed to the increased production. The road improvements achieved by the Demonstration Project will permit further wide conversions of lands from lower to higher economic uses.

5. In Alajuela/Heredia, the central region of maintenance demonstration, the development impact was not as dramatic, since the economic activities were broader-based, most of the roads paved, and deterioration was

of a different nature. No economic analysis was made of benefits from the project in this area.

The recycling demonstration, while very successful in its objectives of improving and reinforcing some sections of important, multi-lane highway, was even further removed from the generation of indirect benefits. In both of these last two cases, the main result of the maintenance, regular or special, was to lower VOC, and for the recycling the increment would be small.

Nevertheless, all savings which result from improved highways have development impact. So do all expenditures for new or better facilities or infrastructure, but often the financial gains accrue to limited numbers of people, as in new private industries, or the social impacts are rather narrow, for instance those produced by new university buildings. On the other hand, those savings derived from more efficient transportation are distributed not only to car and truck owners but to every person who travels by road, or who uses or consumes anything which is moved by road. Money lost because of poor road conditions is absolutely lost. That which is gained from better road conditions is available to the entire range of human activities. Part of it generates development impact.

D. Lessons Learned

To talk about lessons learned has a negative note, but everything learned is valuable, and lessons are often favorable, creating greater interest as well as adding to information.

1. On the positive side, all participants in the Demonstration Project have learned that road maintenance in Costa Rica can be contracted to the private sector, and by this means can be done quickly and effectively. Data available from MOPT is not sufficient to allow cost comparisons, but there are strong indications that, with the experience of this first trial, continued maintenance and rehabilitations can be done by contract at lower cost than by MOPT forces with their present problems of organization and finances.

2. Perhaps the clearest fact learned from the Demonstration Project is that work programs for competitive bidding have to be well-defined. This presented no real problems for periodic maintenance, and for some routine operations like vegetation control, but for the expensive activities of asphalt surface patching and short overlays, there was not enough engineering time available to produce good estimates of total quantities through the contract period. In a varied network of pavements the work is dispersed in some road sections and concentrated in others; if the network is large it

may be necessary in the future to provide for crew travel distance in two or more unit price classes, or provide clear information to bidders on average distances or concentrations.

It has become apparent to all that it will be necessary to recognize, and to make engineering estimates of, any deferred maintenance to be contracted.

3. Well-designed inventories can record the data needed for planning routine maintenance, and perhaps for reasonably uniform rehabilitations of surface or drainage. The experience of the Project indicates that site surveys are required for heavy or uncertain rehabilitations, and for betterments.

4. Despite efforts to make prior legal arrangements, the administrators of the Project had difficulties with exemption from import duties for necessary equipment, and with the classification of grant funds. The lesson learned from this is that government actions are sometimes unpredictable.

5. The ACCCR annual report for 1985 says that there were no contractual problems between the Association and its engineering consultants, but that situations did arise which were resolved on the basis of "Good faith, mutual respect, dialogue and agreement--." It is presumed that

the situations were serious enough to require application of those good qualities on both sides. Present relations seemed to be efficient and fully amicable. The lesson gained is that legal relationships must be drawn carefully even in maintenance demonstrations, and even when the two parties concerned are in a cooperative relationship and not in any sense adversaries.

The report also suggests that there was a rediscovery of the old axiom that owners and engineers should not tell contractor crews, in detail, how to carry out the work. The axiom says that if this is done, the contractor is relieved of responsibility for the quality or results of the work, and that if it has to be done over, someone may have to pay the contractor for the correction. In the demonstration project, because of the need to get started, it was plainly essential to contract for 'time and materials' to some extent, with the executive engineer instructing the contractor on what work was to be done. There is now, and always was, agreement that force account work by the contractor should be minimal.

6. The ACCCR report states that relations with the three contractors of the Project were excellent, but that, in any expanded program of the future, the same good fortune might not occur. The present contractors have exhibited the natural tendency to expand the 'cost

plus' work, and to resist doing unit price work when it becomes more expensive for them, as in the case of widely separated asphalt patching in small amounts. Future contract terms should therefore be reviewed, with maximum use of unit prices which again argues for good program definition. The ACCCR Project Manager expresses the view that the use of small contractors may be advantageous.

7. In the same vein, the 1985 report recognizes the desirability of collecting information to give a better data base for planning. It calls for;

   (a) New inventories,

   (b) Traffic Studies,

   (c) VOC studies,

   (d) Determination of costs for construction, betterment and maintenance,

   (e) Social and economic investigations, and

   (f) Studies of problems of the institutional organization and present administration of the cantonal road system.

8. In the course of the project there were many other details which might have been handled in a different way, but it is important to recognize that most of the lessons learned were positive and productive, as was the project itself.

E. Recommendations

1. Road maintenance by contract should be continued. Road conditions in Costa Rica indicate an urgent need to keep up the present effort and to expand it. Funding should be sought to extend the programs now in place, to carry on routine and periodic maintenance, with the expectation that the "Sixth Highway Project" and the "Fourth Stage, Rural Roads", now under discussion, will include provisions for further development of maintenance by the private sector.

2. The MOPT should be encouraged, and assisted by the ACCCR and others, to increase its use of contract maintenance. Area programs should be developed to save existing infrastructure and to improve road conditions.

   The Maintenance Division of the MOPT has, in its file material, the World Bank Report on Highway Maintenance by Contract in Developing Countries, 6/ which has been useful in the Demonstration Project. This describes the experience of other national governments in utilizing the private sector for maintenance, and supplies good information for guiding steps toward that end.

3. Publicity and meetings should be carried on as at present, to inform the public of the Project's accomplishments and to build interest in and support for contract maintenance.

6/ See Attachment 1.

4. Funds should be sought now for interim data collection and planning, so that work programs can be filled in without delay when funding is available. Studies of comparative maintenance costs, as called for in the ACCCR/MOPT Memorandum of Understanding, may be of importance. Although public sector costs will be difficult to establish, and outside assistance by local specialists may be necessary, the information is basic to program justification. Both financial and economic costs should be considered.

5. In any future project which utilizes the ACCCR or similar institution as administrator, and a 'Construction Committee' or its equivalent in the role occupied by the present committee, the relative authority between the two should be clearly defined.

6. Taking advantage of the skills and information gained from the Demonstration Project, the time and cost of supervisory engineering at the field level should be reduced for similar projects of the future. With more time and information for making up programs, and the possibility of work descriptions and estimates permitting increased unit price bidding, more of the burden of scheduling and execution can be placed on the contractor. However, good engineering supervision will always be needed. It is to be hoped that contractor

experience will also ease the requirement for engineering instruction and control.

7. Interest expressd by MOPT officials in pavement recycling should be encouraged. A lot of Costa Rican pavement is suitable for rejuvenation by this means, and relatively high costs for materials may make it feasible. The MOPT construction division needs to set criteria for this work, for returning thick, distressed surfaces to good condition. Criteria are also needed for relating existing pavement structures and their measured deflections (or equivalent indices) to the projected future truck axle load accumulations, looking for the most economical means of reinforcing pavements.

8. Related to the above, a practical means of measuring road surface roughness ought to be investigated. This is needed for determinations of road surface condition, paved and unpaved, and of the relationship of condition to VOC, in search of economical maintenance levels.

9. If large programs of local road rehabilitation are envisaged, it is recommended that an evaluation be made of producing a more workable all-weather surfacing. The material utilized in Coto Brus, though a wonderful improvement over the previous mud, will be difficult to maintain in a satisfactory condition. Since crushing is

already required in the areas of volcanic geology, the addition of secondary crushing might be justified.

10. It is recommended that a better road inventory procedure be developed, including an improved field sheet for recording data. In highway literature there are many examples of forms which would make it easier to record and read out the data. The form should clearly identify each road section, and should then emphasize the physical features of the section. For maintenance purposes, unrelated data should not be taken. Desired information includes slide locations and others related to emergencies, or a rating of slope (and fill) stability if the condition is general for the section. Density of vegetation should be rated, and the width which requires clearing. Condition ratings of the surface and other elements can be entered if the data will be used at an early date.

    To the field information there should be added, from other sources, traffic volumes and composition, climate zone, pavement age, year of last seal coat and, when available and pertinent, pavement vertical structure, deflections, and roughness.

11. In the interest of economy without any sacrifice of durability, it is recommended that pavement potholes should not be squared in preparation for patching. The

cutting to rectangular shape is a mistaken practice which used to be almost universal, but no longer is. Squaring requires more time to prepare the hole, more materials to make the patch, and more work to compact the mix in the corners. There are studies which indicate that nothing is gained by squaring. The failure in the pavement should be cut back to sound borders without, in geographer's terms, any islands or peninsulas, but all that is justified for good patches is a smoothly regular shape with near-vertical sides.

12. It is recommended that first priority in future contract maintenance programs be given to the rehabilitaion of sections of main national highways which are now showing serious distress. The priority is merited by their importance, VOC savings which would result, and avoidance of the high cost of reconstruction if allowed to fail completely. The work would generally consist of heavy patching (including repair of localized base failures), followed by short leveling/reinforcing overlays, and full-length seal coating. There are many sections of five to twenty kilometers in the central highlands needing this kind of repair and protection.

Second priority projects should be the rehabilitation and minor betterment of local networks such as that of Coto Brus. It is assumed that there are other areas of

similar concentrations of roads serving economic activities of importance.

In the third level of priority should be main national highway sections still in fair to good condition but showing obvious initial distress. These require light patching/reinforcement and, most important, good full-length seal coats with crushed stone cover aggregates, to halt the deterioration. This kind of need exists on main routes of the eastern and western coastal plains, and in the south.

Recycling should be considered on non-municipal urban sections of main highways which consist of old, thick pavements in poor condition because of age and multiple repairs. Candidate highway sections would be those east and west of Cartago; it is presumed that there are others.

In all cases, preliminary planning should be coordinated with the MOPT, to avoid conflict with their project plans. Programs of the kinds mentioned are all highly suited to execution by contracts in the private sector.

ATTACHMENT NO. 1

Sources

1/ Proyecto de un Programa de Corto Plazo Para la Rehabilitacion y Mantenimiento del Sistema Vial--. Ministerio de Obras Publicas y Transportes, Costa Rica, Abril, 1986. (Spanish)

2/ Mantenimiento de Carreteras y Adiestramiento de Personal de Mantenimiento. Informe final de la consultoria en sistemas de administracion de mantenimiento vial. Roy Jorgensen Associates, Inc. - BEL Ingenieria S.A. November, 1984. (Spanish)

3/ Mantenimiento Vial. Resumen ejecutivo de la situacion actual del Ministerio de Obras Publicas. Ing. Ricardo Echandi Z., BEL Ingenieria S.A., Abril, 1986. (Spanish)

4/ ACCCR Informe de Labores 1985, Programa Demostrativo de Mantenimiento y Rehabilitacion de Carreteras, Ing. Carlos Hernandez, Gerente de Proyecto. Prepared in early 1986 and updated in July, 1985. (Spanish)

5/ Informe Anual de Labores, Programa Demostrativo de Mantenimiento de Carreteras por Contrato. BEL Ingenieria S.A. enero de 1986. (Spanish)

6/ An Appraisal of Highway Maintenance by Contract in Developing Countries, by Clell Harral and Ernesto Henriod, The World Bank, and Peter Graziano, Consultant. June, 1985 (Second Edition of the report dated March 3, 1982).

ARTICLE III - STATEMENT OF WORK

The contractor shall analyze the following:

- the efficiency of the planning process for road maintenance including road inventory, ranking of road maintenance, and amount of work (level of service)
- standards for administrative services of maintenance by contract
- efficiency of simplified bidding and contracting procedures
- efficacy of operational procedures and management controls of the contract in the field
- distribution of project funds
- benefit to users of a well-planned contract at an optimal service level
- provide comments and specific recommendations to improve the effectiveness of the project as presently carried out
- identify priority areas and provide recommendations for future investment opportunities, primarily with the private sector.

The contractor shall also include separate sections covering the following points:

1. The development impact of the project. This section should clearly present the development benefits resulting from the project.
2. The project's lessons learned. These should describe the causal relationship factors that proved critical to project success or failure, including necessary political, policy, economic, social and bureaucratic preconditions within the host country and AID. These shold also include a discussion of the techniques or approaches which proved most effective or had to be changed and why. Lessons relating to replicability and sustainability will be discussed.
3. What project benefits are likely to be sustained after AID funding ends?
4. What local institutional capacities (management, technical, financial, provisions for maintenance and the replacement of capital equipment) are being developed to continue project benefits. Will they be in place once AID financing ends? What policy conditions are required to facilitate continued long-term impact?