

**ASIAN DEVELOPMENT BANK**

**PPA:BHU 24350**

**PROJECT PERFORMANCE AUDIT REPORT**

**ON THE**

**EAST-WEST HIGHWAY MAINTENANCE PROJECT  
(Loan 1265-BHU[SF])**

**IN**

**BHUTAN**

**August 2000**

## CURRENCY EQUIVALENTS

Currency Unit – Ngultrum (Nu)

		<b>At Appraisal (October 1993)</b>	<b>At Project Completion (June 1998)</b>	<b>At Operations Evaluation (April 2000)</b>
Nu1.00	=	\$0.032	\$0.023	\$0.023
\$1.00	=	Nu31.44	Nu42.62	Nu42.90

## ABBREVIATIONS

ADB	–	Asian Development Bank
BME	–	benefit monitoring and evaluation
DOR	–	Department of Roads
EIRR	–	economic internal rate of return
IBRO	–	Indian Border Roads Organization
MOC	–	Ministry of Communications
OEM	–	Operations Evaluation Mission
OEO	–	Operations Evaluation Office
PCR	–	project completion report
PCRM	–	Project Completion Review Mission
PMO	–	project management office
PPAR	–	project performance audit report
RMMS	–	road maintenance management system
TA	–	technical assistance

## NOTES

- (i) The fiscal year (FY) of the Government ends on 30 June.
- (ii) In this report, "\$" refers to US dollars.

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**BASIC PROJECT DATA**  
**East-West Highway Maintenance Project (Loan 1265-BHU[SF])**

**A. Project Preparatory/Institution Building**

TA No.	Project Title	Type	Consultant Person- Months	TA Amount	Approval Date
1682-BHU	Road Project	PPTA	12.1	\$250,000	30 Mar 1992
1984-BHU	Development of a Maintenance Management System	ADTA	17.1	\$390,000	18 Nov 1993
1985-BHU	Construction Management	PITA	59.0	\$740,000	18 Nov 1993

ADTA = advisory technical assistance, PITA = project implementation technical assistance, PPTA = project preparatory technical assistance, TA = technical assistance.

**B. Key Project Data**

Item	Currency	In ADB Loan Documents	Actual
Total Project Cost	\$ million	6.51	6.52 <sup>a</sup>
Foreign Currency Cost <sup>b</sup>	\$ million	5.21	5.33
Local Currency Cost	\$ million	1.30	1.18
ADB Loan Amount/Utilization	\$ million	5.21	5.22
	SDR million	3.67	3.67
Foreign Currency Cost	\$ million	4.51	4.60
Local Currency Cost	\$ million	0.70	0.63
ADB Loan Amount Cancellation	\$ million	0.00	0.00

ADB = Asian Development Bank.

<sup>a</sup> Total amount may not add up due to rounding.

<sup>b</sup> Includes interest during construction and consultancy component financed under a grant from the Japan Special Fund.

**C. Key Dates**

Item	Expected	Actual
Fact-Finding		27 Apr-4 May 1993
Appraisal		26-30 Jul 1993
Loan Negotiations		14-15 Oct 1993
Board Approval		18 Nov 1993
Loan Agreement		21 Jan 1994
Loan Effectiveness	21 Apr 1994	8 Mar 1994
First Disbursement		8 Mar 1994
Project Completion	30 Jun 1997	31 Dec 1997
Loan Closing	31 Dec 1997	13 May 1998
Months (Effectiveness to Completion)	40	46

**D. Key Performance Indicator (%)**

<b>Indicator</b>	<b>Appraisal</b>	<b>PCR</b>	<b>PPAR</b>
Economic Internal Rate of Return	45	39	n.c.

n.c. = not calculated, PCR = project completion report, PPAR = project performance audit report.

**E. Borrower** Kingdom of Bhutan

**F. Executing Agency** Department of Roads, Ministry of Communications

**G. Mission Data**

<b>Type of Mission</b>	<b>No. of Missions</b>	<b>Person-days</b>
Fact-Finding	1	50
Appraisal	1	20
Project Administration:		
Inception	1	5
Review	3	12
Project Completion Review	1	51
<b>Subtotal Project Administration</b>	<b>5</b>	<b>68</b>
Operations Evaluation	1	66
<b>Total</b>	<b>8</b>	<b>204</b>

## EXECUTIVE SUMMARY

*"No rigid designs to a fluid project situation please"*

Over the last decade, responsibility for Bhutan's road network has been gradually transferred from the Indian Border Roads Organization (IBRO) to the Department of Roads (DOR) of the Ministry of Communications. At project formulation, there was an urgent need to reduce the substantial backlog of periodic maintenance, which had built up since DOR took over maintenance of a number of national roads from IBRO in 1989, including the East-West Highway.

The East-West Highway Maintenance Project was formulated through a feasibility study financed by the Asian Development Bank (ADB), which identified periodic maintenance interventions for selected sections of the project road. The condition of the road surface varied from section to section, ranging from good to disintegrating. Although many road sections were in need of complete rehabilitation and reconstruction, they were not included in the project scope, because the cost of repairing them would have exceeded the envisaged loan amount. The project scope comprised (i) periodic maintenance works on 396 kilometers (km) of the 546 km road, (ii) strengthening and maintenance works on five bridges on the East-West Highway, (iii) consulting services to assist DOR with preconstruction activities and construction supervision, (iv) institutional strengthening of DOR through the development of a road maintenance management system (RMMS), and (v) strengthening DOR's institutional skills in planning road maintenance works and administering contracts. The Project also helped to establish a capacity for mechanized periodic maintenance in Bhutan.

Given the physical and institutional needs of the roads sector, the Project as conceived at appraisal and evaluated after seven years was, and still is, highly relevant. The Project's inclusion in the ADB country assistance plan was merited not only for economic reasons but also because the project road is the only east-west transport artery within Bhutan. Although motorized traffic on the road has been low and traffic growth moderate, the road is important because of its strategic role within the overall road network of the country. Overall, the Project's rationale of combining physical improvements with capacity building remains highly relevant.

Project implementation was scheduled over 48 months from July 1993 to June 1997. Actual implementation took only 46 months from March 1994 to December 1997. Preconstruction activities suffered a seven-month delay due to the delayed recruitment of the supervision consultants who were to assist with these activities. Further delays arose due to the initial poor response to the invitation to tender for the works and the subsequent contract negotiations with the selected contractors. The Project finished on time largely because of a reduction in project scope during implementation.

Total project cost was \$6.52 million equivalent, compared with \$6.51 million equivalent estimated at appraisal. However, this comparison is somewhat misleading: with a reduction in the scale of civil works by about 35 percent, there was a substantial increase in the cost of civil works per kilometer. The final cost of the road works was \$5.54 million, an increase of about 24 percent over the appraisal estimate. The average cost per kilometer was \$21,400 compared with the appraisal estimate of \$11,300, an increase of 89 percent.

The rise in the cost per kilometer was due to a rapid deterioration of the road surface between the time of the feasibility study and project implementation. When construction finally commenced, many of the road sections had deteriorated to a state where the periodic maintenance interventions proposed by the feasibility study were no longer appropriate, so the location and nature of civil works were revised considerably.

An accurate assessment of project efficiency (i.e., actual and expected project benefits in relation to project inputs) is problematic because of the lack of baseline data, the delays in project implementation that caused a shift in project scope, and the general difficulty of formulating a more verifiable counterfactual scenario. Nonetheless, given the strategic significance of the road and the fact that further deterioration would have rendered the road unusable, isolating vast areas of the country, any intervention to improve the current situation would have yielded very high economic returns.

Institutional development is a learning process and the Project laid the foundation for future efforts. However, it did not directly and noticeably enhance institutional development. The road maintenance management system chosen for the Project is unsuitable to conditions in Bhutan. DOR's skills in contract management were strengthened, but the number of staff available for contract management and the supervision of civil works is insufficient. The Project supported the Government policy of transforming DOR into a supervisory body and delegating traditional DOR functions to the private sector. Through policy dialogue, the Project attempted to increase cost recovery and budget allocations for road maintenance. While cost recovery remained elusive, some progress was made in increasing budget allocations.

The reconstruction and drainage improvements made under the Project will lengthen the life of the pavement. Other project interventions were designed to protect the pavement for a limited period that is now about to expire. Some of the road sections covered by the Project are already showing signs of deterioration, needing another round of periodic maintenance. The sustainability of the Project's institutional efforts hinges on the willingness and ability of DOR and ADB to continue the learning process that was started under the Project. It is reassuring that ADB is processing another project to support the roads sector.

The Project as a whole did not fully meet its objectives, but overall project performance is rated successful. The physical targets set at appraisal were only partly achieved. However, the shift made during implementation to heavier maintenance interventions was generally consistent with the Project's purpose of reducing the backlog of repairs. The Project only partly met the objectives of promoting the institutional development of DOR and building capacity in the roads sector at large. Maintenance management improved marginally and construction supervision and contract management remain areas of concern.

The Operations Evaluation Mission has identified the following key issues:

- (i) Many weaknesses in the design of the Project and its implementation were skirted or overlooked by the project completion report (PCR). This raises the general issue of self-evaluation and the PCR's value as a learning tool.
- (ii) Since road conditions in Bhutan change quickly and unpredictably, the recommendations of the feasibility study were no longer fully relevant when the Project began. The type of interventions represented straightforward maintenance work, for which a full-fledged feasibility study may not have been necessary. Detailed engineering just before the commencement of works may have sufficed.



- (iii) Reconstruction was excluded from the original design, although its urgency was known at appraisal, raising the question of how the accumulating repair needs on this strategic road were to have been addressed. This is a programming concern, which could have been dealt with by appropriately sequencing ADB's assistance and breaking it up into several interventions.
- (iv) Efforts are under way to transform DOR into a regulatory agency and delegate its current operational functions to the private sector. ADB supports this policy. Given the shortage of trained engineers in Bhutan, the private sector would be likely to recruit the few skilled staff of DOR. It is unclear who in DOR should regulate the industry if many of its staff migrated to the private sector.

The key lessons from ADB's project experience include the following:

- (i) Given the situation in Bhutan, project designs need to provide flexibility during implementation. A design that included only three types of periodic maintenance interventions has proven to be too rigid and impractical. In hindsight, a sector-type approach would have avoided many of the ad hoc adjustments and the confusion that arose from them. By dividing the work into subprojects to be implemented on a rolling basis, the Project would have been less susceptible to the risks inherent in a rigid design.
- (ii) The fact that urgently needed reconstruction was excluded from the original design shows that the design was driven more by the given loan amount than by needs. The strategic significance of the project road and the substantial backlog of repair work should have been ascertained during the country assistance plan process. A longer-term program rather than a one-off project should have ensued from this consideration.
- (iii) ADB's general policy of financing supervisory services from loan funds was not followed, to the detriment of the Project. ADB should stress the importance of professional construction supervision and should insist on loan financing as this would help instill a sense of ownership and responsibility in the executing agency.
- (iv) The RMMS followed a rigid approach to institutional development, without adaptation to local conditions, and the system installed under the TA was not a success. While Bhutan needs an information system for the management of road maintenance, ADB in consultation with DOR should have exercised greater diligence in identifying the main design features of the system in the light of their suitability for the special conditions of Bhutan.
- (v) There are obvious intrinsic merits in the maintenance of assets, but the maintenance interventions under the Project were given an extra economic justification. Given the unnecessary and largely unverifiable nature of the assumptions made, ADB should abandon the practice of such tautological economic analysis. The economic evaluation for road maintenance projects should focus on the timeliness and cost-effectiveness of the proposed interventions.

## **I. BACKGROUND**

### **A. Rationale**

1. By the time the Project was formulated in 1993, Bhutan's road network had grown from a few hundred kilometers (km) constructed in the 1950s to about 3,000 km. From 1960 to 1980, three north-south roads were built from the Indian border to the interior of the country. Construction of the project road, the only east-west transport artery within Bhutan, was completed in 1985. Although motorized traffic on the road has been low and traffic growth moderate, the road is important because it provides the only means of transport between the two important centers of Thimphu in the west and Trashigang in the east (map). The road serves the villages north and south of it and plays an important role in the administration of these regions and their socioeconomic development. With the Government's current emphasis on building rural access roads, the project road's significance is likely to increase. The population served by the road is estimated at 250,000, equivalent to about 25 percent of Bhutan's total population. In the hinterland of the road, as elsewhere in Bhutan, agriculture is the dominant economic activity, followed by light industry, trade, and government services.

2. Maintaining roads in Bhutan is a formidable task. Roads are subjected to extreme weather conditions, and landslides, giving rise to rapid natural and often unpredictable road deterioration. The project road, which passes through altitudes ranging from 650 to 3,800 meters, had been affected by these conditions. Thus, when the Project was formulated, many sections were in a poor state of repair and some in an imminent state of disintegration. It was determined at that time that the road was in urgent need of periodic maintenance and its most severely affected sections in need of reconstruction. The cost of this work was found to be beyond the Government's means and assistance was therefore requested from the Asian Development Bank (ADB).

3. In the past 30 years, the Indian Border Roads Organization (IBRO) has undertaken most of the construction and maintenance works on Bhutan's road network. Over the last decade, however, responsibility for the road network has been gradually transferred to the Department of Roads (DOR) of the Ministry of Communications (MOC). Over time, this has raised the issue of DOR's ability to maintain roads and ensure that available resources are used efficiently. Along with the physical road improvements, institutional strengthening of DOR was considered necessary. The focus here was on enhancing DOR's contract management capability and introducing a management system for the maintenance of the national road network.

### **B. Formulation**

4. The Project was based on feasibility and engineering studies prepared in FY1993 under an ADB-funded technical assistance (TA) grant.<sup>1</sup> The TA report was comprehensive, well-prepared, and consistent with the main objectives of the study, which were to

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<sup>1</sup> TA 1682-BHU: *Road Project*, for \$250,000, approved on 30 March 1992.

- (i) design an economically viable periodic maintenance project to prevent deterioration of the existing paved sections of the road,
- (ii) initiate mechanized pavement sealing<sup>2</sup> by contracting periodic maintenance works to privately owned contractors, and
- (iii) strengthen the institutional capabilities of DOR in pavement management planning and contract administration.

5. The feasibility study consultants found road conditions ranging from good to disintegrating pavements. Another challenge was the speed and unpredictability with which road conditions tend to change in Bhutan under the impact of landslides, monsoon rains, frost, and snowfall. These circumstances were to have serious consequences for the relevance and applicability of the designs recommended by the consultants. When construction commenced about three years later, many of the road sections had deteriorated to a state where the periodic maintenance proposed by the feasibility study was no longer appropriate to restore those sections to a sustainable serviceable state (para. 15).

### **C. Purpose and Outputs**

6. The study identified those sections of the road that needed one of three types of resurfacing,<sup>3</sup> but excluded landslide-affected areas and very highly deteriorated sections requiring reconstruction. In all, 396 km<sup>4</sup> out of a total of 546 km were recommended for periodic maintenance. Ninety-one km were identified as not needing any intervention and 59 km as needing reconstruction (Appendix 1). The scope of the Project further included (i) strengthening and maintenance works on five bridges on the East-West Highway; (ii) consulting services to assist DOR with prequalification, bid evaluation, and construction supervision; and (iii) institutional strengthening of DOR through the development of a road maintenance management system (RMMS).

7. The principal purpose of the Project was to assist DOR in reducing the substantial backlog of periodic maintenance that had built up since DOR took over maintenance of a number of national roads from IBRO in 1989, including the East-West Highway. Under the TA study, periodic maintenance interventions were identified for specified sections of the road, and the establishment of a pavement maintenance management system was recommended. Both these components were implemented under the Project. Secondary project objectives were the

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<sup>2</sup> Sealing is the application of surface dressing (surface treatment in the United States). Surface dressing is a wearing course made by a thin film of binder which is sprayed on the road surface and immediately covered with a single layer of stone chippings of uniform size. Surface dressing provides a dust-free and durable running surface with good skid resistance. It has no structural strength in itself but provides a waterproof seal thus preserving the inherent strength of the pavement and subgrade.

<sup>3</sup> These were (i) surface enrichment, (ii) single bituminous surface treatment, and (iii) double bituminous surface treatment and reshaping. A single surface treatment consists of one application of binder and chippings. It is adequate as a wearing course on lightly trafficked roads and as a maintenance measure on existing asphalt pavements. Double surface treatment is used on roads expected to carry more than 100 vehicles per day and in cases where available chippings are poorly shaped or very weak.

<sup>4</sup> This total includes about 56 km of works subsequently excluded from the Project when the Trashigang-Mongar section was handed over to IBRO for maintenance.

strengthening of DOR's institutional skills in maintenance planning and contract administration and assistance in establishing mechanized periodic maintenance capabilities by contracting the work out to private contractors. This type of work had previously been carried out by force account under DOR.

8. When the Project was formulated, the Government had decided to hand over all maintenance works to private contractors and to gradually transform DOR into a regulatory agency. The Project was to support this objective by promoting the fledgling contracting industry and by contracting out most of the pavement sealing works. The Project succeeded in training five local contractors in mechanized sealing works, although considerable difficulties were experienced initially. The momentum generated by the Project has not been sustained due to insufficient new work being given out to contractors since the completion of the Project.<sup>5</sup>

9. The RMMS set up under the TA was to provide a management tool for prioritizing, scheduling, and resource planning for road maintenance activities. The Project was to establish a database containing an inventory of roads and pavement conditions. This database was subsequently to be updated at regular intervals by DOR staff. A computerized deterioration model calibrated to suit conditions in Bhutan was to generate intervention types, schedules, and budget allocations. DOR staff were to be trained to use the system.

#### **D. Cost, Financing, and Executing Arrangements**

10. The estimated cost of the Project at appraisal was \$6.51 million, of which \$5.21 million was the foreign currency cost<sup>6</sup> and \$1.3 million equivalent was the local currency cost (Basic Data). On 13 November 1993, ADB approved a loan of SDR3.67 million, then equivalent to \$5.22 million, from its Special Funds (SF) resources to finance \$4.51 million of the foreign currency cost and \$0.70 million equivalent of the local currency cost. Parallel to this loan, a TA grant of \$0.74 million was provided by the Japan Special Fund<sup>7</sup> to finance the foreign currency costs of the consulting services component estimated at \$0.70 million. The balance of \$0.04 million equivalent was financed by the Borrower. The Borrower was the Kingdom of Bhutan and the Executing Agency was the roads section of the then Public Works Division of MOC, which is now DOR. ADB is currently processing a third loan for the roads sector through a proposed Road Improvement Project.<sup>8</sup>

#### **E. Completion and Self-Evaluation**

11. The civil works under the Project started in 1994 and were completed by December 1997. The ADB loan was closed on 13 May 1998. The Project Completion Review Mission (PCRM) visited the country in 1998. The project completion report (PCR) was prepared by

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<sup>5</sup> It was estimated in the TA study that about 60 km of sealing works per year would need to be given to each of the five contractors engaged under the Project for their investments in specialized equipment to be profitable.

<sup>6</sup> The amount includes \$0.20 million for service charges on the ADB loan during construction.

<sup>7</sup> TA 1985-BHU: *Construction Management*, for \$740,000, approved on 18 November 1993.

<sup>8</sup> BHU 32288 [SF]: *Road Improvement Project*, proposed for \$9.6 million.

ADB's Infrastructure (West) Department – Transport and Communications Division, and circulated to the ADB Board of Directors in December 1998.<sup>9</sup>

12. The PCR accurately reports the events that caused changes in the project design during implementation. According to the PCR, the Project largely met the objective of arresting the deterioration of the road sections covered by the Project. The PCR emphasizes the significance of the project road in benefiting the Bhutanese population at large. While more detailed studies to substantiate this claim have not been made, the OEM fully endorses this view. The PCR suggests that nonquantifiable benefits include reduced travel time for goods and passengers, and uninterrupted supply of essential public services and access to markets. The OEM concurs with these findings.

13. On the other hand, the PCR, as a self-evaluation exercise, did not assess at all, or merely skirted, the problems that have occurred before and during project implementation. Overall, the PCR's contribution to identifying lessons for future project designs is marginal at best. Particularly serious shortcomings of the PCR are that it

- (i) did not examine the merits of the feasibility study approach given Bhutan's quickly changing road conditions;
- (ii) did not question the original project design that excluded urgent but more costly road interventions although those interventions were later considered necessary and included in the Project at the expense of components originally envisaged;
- (iii) made it appear that the Project broadly stayed within the appraisal cost estimates, veiling the fact that per-km costs almost doubled;
- (iv) did not analyze major shortcomings in the arrangements for construction supervision and did not identify the type of works that were actually accomplished;
- (v) more or less replicated the economic evaluation adopted at appraisal despite project costs that had almost doubled and despite a much lower benefit-generating base resulting from the reduced project scope; and
- (vi) drew conclusions from the failure of the RMMS TA that put the blame squarely on the software, consultants, and counterpart staff, instead of examining the appropriateness of the RMMS in the light of the very limited local capacity to maintain and operate a state-of-the-art system.<sup>10</sup>

## **F. OEO Evaluation**

14. This project performance audit report (PPAR) focuses on the appropriateness of project formulation and design, the efficacy and the efficiency of project implementation, the achievement of project objectives, and the sustainability of realized benefits and project

<sup>9</sup> PCR: BHU 24350: *East-West Highway Maintenance Project*, December 1998.

<sup>10</sup> PCR: BHU 24350: *East-West Highway Maintenance Project*, December 1998, page 8.

impacts. The PPAR presents the findings of an Operations Evaluation Mission, that visited Bhutan, from 29 March to 19 April 2000. OEM members met Government officials and private contractors concerned with road construction in Bhutan and traveled on the project road. Special attention was paid to evaluating the condition of the road pavement and its maintenance. In preparing the PPAR, OEM members also reviewed the appraisal report, the PCR, feasibility study, final reports of the associated TA, back-to-office reports of review missions, and other relevant materials in ADB's files.

## II. PLANNING AND IMPLEMENTATION PERFORMANCE

### A. Formulation and Design

15. The maintenance interventions identified in the TA study may have been appropriate for the conditions of the road at the time the TA was undertaken in 1992, but the possibility of progressive road deterioration from then until the time of implementation was not taken into account. The deterioration was exacerbated by the delayed start of implementation.<sup>11</sup> The result was that a great deal of time and funds had to be spent on presealing works, including pothole repairs, extensive deep patching, and limited reconstruction. Although it was known at appraisal that certain road sections were in need of complete rehabilitation and reconstruction, they were not included in the project scope, as they would have required “a much larger capital investment, which cannot be funded under the proposed loan.”<sup>12</sup> With the original project design focused on periodic maintenance having become obsolete to some extent, the project scope “shifted from less expensive surface improvement and single chip seal to the more expensive double chip reseal.”<sup>13</sup> As a result, in addition to the extensive presealing works, where surface enrichment had been planned a single chip seal was now required, and where a single chip had been scheduled reshaping and double chip sealing was required. The shift in project scope from relatively straightforward periodic maintenance to heavier construction interventions caused a 35 percent reduction in road kilometers covered by the Project.

16. DOR’s explanation for this outcome centers on the unexpected pace of road deterioration that had occurred during the period between the feasibility study and actual construction. This view was also adopted by ADB’s review missions and in the PCR. Whatever the cause or combination of causes may have been, the type of civil works actually carried out, and their location, were considerably revised compared with the recommendations of the feasibility study and the project design eventually adopted by ADB’s fact-finding and appraisal missions. Thus, the feasibility study had to a certain extent missed its purpose. When ADB appraised the Project in July 1993, there was some evidence of the progressing road deterioration. As a result, the appraisal mission decided that additional detailed inspections would be carried out during project implementation and that, as a result of this, “some minor changes”<sup>14</sup> may be expected.

17. The design of the Project followed the traditional project approach with a feasibility study defining the proposed type of interventions, estimating their costs, and determining their location. The economic evaluation in the appraisal report was based on this concept. In retrospect, the appropriateness of this approach appears doubtful for the following reasons:

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<sup>11</sup> Three contracts were awarded in April, July, and September 1994 and the other two in April 1995. Construction work began in early 1995.

<sup>12</sup> ADB Appraisal Mission. 1993. *Proposed East-West Highway Maintenance Project*. Memorandum of Understanding with the Royal Government of Bhutan signed on 30 July.

<sup>13</sup> ADB Loan Review Mission. 1997. *East-West Highway Maintenance Project*. Back-to-office report dated 1 September.

<sup>14</sup> See Footnote 11.

- (i) pavement conditions vary along different sections of the 546 km long East-West Highway because the sections are exposed to different climatic conditions and the highway has not been maintained in a cohesive manner; and
- (ii) owing to the severe climatic and unstable geological conditions, road surfaces tend to change rapidly, making the recommendations of feasibility studies obsolete within a short time.

18. The numerous changes made to the scope of the Project during implementation are a direct result of these factors. Thus, a design that included only three types of periodic maintenance interventions has proven to be too rigid and impractical. The fact that reconstruction was excluded from the original design although its urgency was known at appraisal shows the design was driven more by the given loan amount than by needs.<sup>15</sup> ADB review missions responded sensibly and flexibly to the challenges as and when they emerged. In concentrating the loan funds on the most needy sections they contributed a great deal to the success of the Project. In hindsight, a sector approach would have provided the necessary flexibility and avoided many of the ad hoc adjustments and the confusion that arose from them. Under a sector approach, the work could have been divided into small subprojects that would have been designed in accordance with the state of the roads during implementation rather than some years before.

## **B. Cost and Scheduling**

19. The actual total project cost was \$6.52 million equivalent compared with \$6.51 million equivalent estimated at appraisal. The costs and financing arrangements are detailed in Appendix 2. ADB disbursed about \$5.22 million. The actual project expenditures are in line with those given in the PCR. Nonetheless, this comparison is misleading. It masks the fact that due to a reduction in the scope of civil works by about 35 percent, there was a substantial increase in the cost of civil works per km. The final cost of the road works was \$5.54 million, an increase of about 24 percent over the appraisal estimate. However, the average cost per km was \$21,400 compared with the appraisal estimate of \$11,300, an increase of 89 percent (Appendix 3). The reason for this doubling of the per-km cost was explained by DOR as being due to a rapid deterioration of the road surface between the time of the TA study and project implementation, requiring more costly interventions than envisaged under the TA (para. 15).

20. Implementation of the Project was scheduled over 48 months from July 1993 to June 1997, including precontract activities. Actual implementation took 46 months from March 1994 to December 1997.<sup>16</sup> Construction contracts were awarded to three contractors between April and September 1994, and to the remaining two contractors in April 1995. Construction work started in earnest in early 1995 and was halted in December 1997 when the loan proceeds had been fully used.

<sup>15</sup> The Memorandum of Understanding of the Appraisal Mission states the following: "Road sections currently requiring reconstruction work and road sections in unstable areas (about 59 km) have been excluded from the scope of the Project as these will require a much larger capital investment which cannot be funded under the proposed loan." The logic of this reasoning is not clear: if the Government needed ADB assistance for the relatively minor works, who was expected to address the more serious and costly deficiencies of the road?

<sup>16</sup> One contractor was given a time extension until June 1998.



21. Preconstruction activities suffered from a seven-month delay due to the delayed start of the consultants who were to supervise these activities. Further delays arose due to the initial poor response to the invitation to tender for the works and the subsequent contract negotiations with the selected contractors. Four of the five contractors completed construction within their contract periods<sup>17</sup> and one was given a four and then a six-month extension to do enough work to cover his advance payment.

### **C. Consultants' Performance, Procurement, and Construction**

22. Four construction contracts<sup>18</sup> were originally tendered under local competitive bidding,<sup>19</sup> but the tendering process encountered a number of problems. Of the 18 prequalified contractors, only 5 submitted bids and only 1 of these was considered acceptable. With ADB's concurrence, the first contract was awarded to the responsive bidder and the other 4 on the basis of directly negotiated contracts at the same unit rates as agreed with the first contractor. These rates were generally within the appraisal estimates. Three of the latter 4 were companies newly set up for the Project. International consultants were recruited under separate TA grants to supervise construction<sup>20</sup> and to establish the RMMS in accordance with ADB guidelines.<sup>21</sup>

23. The contractors faced considerable difficulties in starting the work. Of the five contracting firms that participated in the civil works, three had been newly formed and the Project helped to expand the capabilities of the two existing firms to cover surface dressing. Having no previous experience in sealing works, all firms lacked equipment, skilled human resources, and capital resources. DOR sold off some of its own sealing equipment and crushers, which were later supplemented with equipment procured internationally. Because the advance given to the contractors was not sufficient to cover the cost of new equipment, secondhand equipment was purchased from various international sources. Much of the equipment either arrived in an unserviceable condition or broke down in a matter of weeks and remained unserviceable for very long periods. This significantly affected the performance of the contractors. During the course of construction, four of the five contractors became proficient in mechanized road surface sealing techniques and performed satisfactorily, but the fifth was unable to make his equipment operable. Against a target of 51 km, the contractor only repaired 1 km by mechanized means and was therefore finally allowed to repair a further 14 km by manually mixed and laid premix.

24. The surface sealing was further delayed by the extent of preparatory works that needed to be undertaken due to the deterioration of the pavement subsequent to the submission of the feasibility study report. These works comprised extensive patching, reshaping, and crack sealing of road surfaces. The production of stone chips was delayed because of (i) delays in the approval of quarry sites and the establishment of quarries, (ii) crushing plants that were inoperable or of an inadequate size, and (iii) lack of equipment at the quarries.

<sup>17</sup> Thirty-six months for contracts 2 and 3, and 30 months for contracts 1, 4, and 5.

<sup>18</sup> The back-to-office report of an ADB loan Review Mission (13 May 1994) cited three contracts, but the OEM understood from DOR that the work was split into four contracts.

<sup>19</sup> One of these was subsequently divided into two contracts.

<sup>20</sup> TA 1985-BHU: *Construction Management*, for \$740,000, approved on 18 November 1993.

<sup>21</sup> TA 1984-BHU: *Development of a Maintenance Management System*, for \$390,000, approved on 18 November 1993.

25. Two of the five bridges to be rehabilitated under the Project were handed over to the DANTAK project<sup>22</sup> for replacement under the Indian-financed Kurichhu Hydro Power Project. The remaining three bridges were subsequently identified for replacement under grant assistance from the Japan International Cooperation Agency and Helvetas, the Swiss Association for International Cooperation. As a result, only a small amount of replacement parts and minor construction equipment were procured under the Project with the installation work being done through the DOR force account.

## **D. Organization and Management**

### **1. Maintenance Works**

26. As envisaged at appraisal, DOR acted as the Executing Agency. It established a project management office (PMO) headed by a superintending engineer (road maintenance) in DOR, who acted as project manager. Two international road engineers supervised construction, trained contractors in sealing works, and assisted the project manager. In response to a request from the Government, the two supervisory consultants were financed from TA grant funds and were therefore engaged by ADB in consultation with DOR.

27. While DOR was generally satisfied with the consultants' performance, ADB and DOR both expressed some concern about the implications of the recruitment arrangements. At times the consultants' sense of accountability was directed toward their employer, i.e., ADB, rather than toward the client. The fact that ADB funded and selected the consultants contributed to a dilution of the chain of command within the PMO. It detracted from the local PMO staff's sense of ownership of, and responsibility for, the project works. Because the terms of reference of the consultants specifically included assisting DOR and contractors with the procurement of the main types of equipment, criticism was leveled at the consultants, when the equipment procured secondhand did not arrive in serviceable condition (para. 23). As a consequence, when the TA funds were exhausted, some nine months before construction ended, the Government did not agree to use loan funds for the continuation of construction supervision and terminated the contract of one consultant.

28. The PCRM rated DOR's performance as satisfactory and the OEM concurs with this. However, DOR could make considerable improvements in its maintenance of construction records and project accounts. Information about the locations of the works completed under the various categories was not readily available to the PCRM.<sup>23</sup> It was unfortunate that the supervision consultant was terminated before construction ended, as his assistance in preparing the project records would have been useful.

### **2. Road Maintenance Management System**

29. One engineer from DOR was assigned to work full time with the RMMS consultants to learn to gather and input data, and continue to produce the outputs of the RMMS after project completion. Unfortunately, this engineer left DOR due to ill health, and no substitute has been trained to replace him. Because of this, no one in DOR knows how to operate the system. The

<sup>22</sup> The DANTAK project is the IBRO project that constructed the National Highways in Bhutan.

<sup>23</sup> This information was submitted to ADB after completion of the OEM.

same is true of the Bump Integrator<sup>24</sup> and the Benkleman Beam equipment<sup>25</sup> which are to assess road conditions. To date, only the consultants engaged to conduct a road network study under another ADB-funded project<sup>26</sup> have used this equipment.

### **3. Compliance with Loan Covenants**

30. The OEM concurs with the PCR's assessment of the Government's compliance with loan covenants. All major loan covenants related to loan approval have been complied with except for one, which pertains to benefit monitoring and evaluation (BME). BME, which was to be undertaken by DOR with assistance from the project supervision consultant, was not carried out. The consultant's contract was terminated prematurely, as funding from the TA grant for construction supervision was already fully used (para. 27).

## **III. ACHIEVEMENT OF PROJECT PURPOSE**

### **A. Operational Performance**

31. The quality of the civil works carried out under the Project was mixed. An accurate assessment of the quality of the project-maintained road sections was hampered by the difficulty in differentiating sections of newly sealed road surface from the original pavement. An approximate assessment of pavement condition based on observations by the OEM while driving over the road is given in the line diagram in Appendix 4. This diagram also shows the sections on which maintenance works were carried out as reported in DOR's completion report. The figure (page 10) summarizes the pavement condition noted by the OEM for the section of the road between Km 115 (end of the road section being maintained by the DANTAK project) and Km 546. While 60 percent of the road is in fair to good condition, the remainder is in urgent need of resealing or reconstruction. A more detailed examination of road conditions is provided in Appendix 4.

32. The RMMS was not found to be appropriate to DOR's stage of institutional development or to conditions in Bhutan. The inventory database that was installed was unduly complicated and data collection too cumbersome to be sustained after completion of the Project. The RMMS was based on a deterioration model, which was not calibrated to suit Bhutanese conditions. The resulting outputs of maintenance programming for budget allocation were far in excess of previous allocations and far exceeded the Ministry of Finance resources available for road maintenance. Furthermore, only one DOR staff member was trained to use the RMMS, and

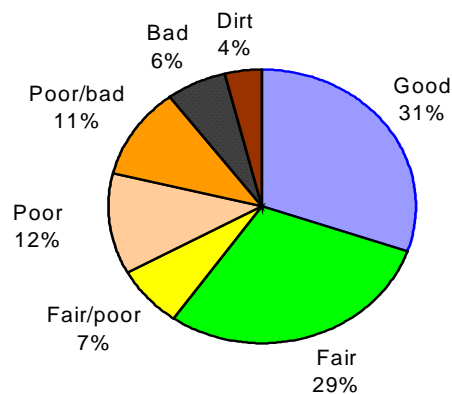
<sup>24</sup> The Bump Integrator is a response-type roughness meter which records relative displacements between the rear axle and body of a running vehicle. It can be installed in an ordinary passenger car or is available as a one-wheeled trailer.

<sup>25</sup> A widely used method for designing road overlays is based on the use of Benkleman beam deflection measurements in assessing the strength of existing pavements. The Benkleman beam of deflection measurement is a simple load test, where the dual rear wheels of a heavy truck are used as the load. The Benkleman beam consists of a slender pivoted arm, 3-4 meter long, which can be placed between the dual wheels. Benkleman beam measurements are made at the time of year when the pavement is at its weakest, i.e., its wettest condition.

<sup>26</sup> TA 3107-BHU: *Road Transport Network Development*, for \$650,000, approved on 3 December 1998.

there is now no one in DOR capable of operating the system (para. 29). The original database has never been updated and it has not been used since the TA consultants handed over the system to DOR. According to the PCRM,<sup>27</sup> the Government expressed some dissatisfaction with the RMMS. The PCRM noted that the maintenance management consultants had installed a system less suitable than commercially available state-of-the-art systems. The PCRM recommended that the RMMS be extensively modified, with changes as required to the inventory data collection, and that the analysis module be replaced by a system based on the highway design and maintenance model<sup>28</sup> adopted by the World Bank.

### Summary of Present Pavement Condition



Condition rating:

- Good: very few defects, good profile, fairly smooth
- Fair: some defects (cracking, potholes, depressions), pavement generally intact
- Poor: frequent cracking and potholes, some subgrade failures, rough surface
- Bad: frequent subgrade failures, pavement disintegrating, very rough

Source: Operations Evaluation Mission estimates.

33. The OEM generally concurs with this assessment, but doubts whether it would be technically feasible or desirable to modify the system as proposed. The applicability of the highway design and maintenance deterioration model to Bhutan is doubtful, due to the complex nature of this model. Its incorporation into the existing RMMS, if at all possible, would only result

<sup>27</sup> ADB Project Completion Review Mission. 1998. Loan 1265-BHU: *East-West Highway Maintenance Project*; TA 1984-BHU: *Development of a Maintenance Management System*; and TA 1985-BHU: *Construction Management*. Back-to-Office Report dated 17 July.

<sup>28</sup> Developed by the World Bank, the Highways Design and Maintenance Standards Model (HDM), (volume III), is used to make comparative cost estimates and economic evaluations of different policy options ranging from basic maintenance to new construction including different time staging strategies, either for a given road project on a specific alignment or for groups of links on an entire network. It consists of mathematical relationships which forecast the behavior of a road pavement under specified climatic, maintenance, and traffic conditions. Three interacting sets of cost relationships (i.e., construction costs, maintenance costs, and road user costs) are added together over time in discounted present values. Road user costs include operating costs and time costs. Vehicle speed, which is a major determinant of vehicle operating costs, is related through a complex set of probabilistic functions to road geometric design, surface condition, vehicle type, and driver behavior.

in an even more complicated system. What is really needed is a simple system that is easy to understand and to maintain, and one that can be adapted to the special conditions of Bhutan.

## **B. Performance of the Operating Entity**

34. DOR has evolved over the last five years as a project management and supervisory agency, and road works are now being undertaken mainly by the private sector. However, DOR has continued to undertake some special works, including selected resurfacing and a small number of bypass construction schemes. DOR's Mechanical Cell has recently been instructed to become financially self-sufficient by hiring out plant and equipment on commercial terms to both the private sector and other Government institutions. Other than that, DOR's only source of financing is the annual budget allocation from the Government. Such allocation increased by an average of 23 percent per annum from 1993 to 1999. This increase significantly exceeded the growth in general Government revenues (13.2 percent) during the same period. Given the fact that hardly any new road construction is undertaken in Bhutan, this increase reflects the high priority that the Government accords to road maintenance.

35. The Government levies a range of taxes and fees on road users. While the contribution of such revenues to cost recovery has increased from about 20 percent to about 25 percent over the last five years, the objective of achieving full cost recovery remains elusive. The number of vehicles, and the related tax base, are low in Bhutan and must be set against the relatively high cost of constructing and maintaining roads. Current suggestions to earmark revenues from road users and to establish a road fund would have more merit if road user charges made a net contribution to the general budget. However, such suggestions appear misguided when the general budget subsidizes the road sector.

## **C. Sustainability**

### **1. Maintenance Interventions**

36. Most of the road sections repaired under the project 4-5 years ago are beginning to show signs of distress. These will need a resealing of the surface in the near future to ensure sustainability. To further raise sustainability, road conditions should be monitored periodically through an annual or biannual pavement inventory. In addition, the pavement structures of some sections are not sufficient for the axle loadings imposed by logging trucks. Short sections of many of the surfaces sealed under the Project are being damaged by works to widen curves, currently being carried out by DOR, and will need to be repaired when this work is completed. Overall, the prospects for sustainability are mixed and the Project's objective of reducing the backlog of periodic maintenance has been only partially realized.

37. The good start made at introducing mechanized surface sealing techniques by private contractors has not been sustained due to a lack of sealing contracts of sufficient size since project completion. It was estimated that about 300 km per year would need to be contracted out to the five sealing contractors for their investments in the specialized equipment to give a

reasonable return. However, only a few contracts for short sections have been awarded. As a result, equipment is lying idle, and the skills acquired are gradually being forgotten.

## **2. Institutional Strengthening**

38. DOR's skills in contract management have been strengthened under the Project. However, DOR still lacks qualified staff to systematically collect and update data on pavement conditions and to supervise civil works. This situation is being exacerbated by the Government's policy of reducing DOR staff and the pressure of new projects recently started or in the pipeline.

39. MOC has recently carried out a reorganization whereby the roads and bridges sections have now been separated, each section is headed by a superintending engineer. The central laboratory in Thimphu has been moved out of DOR to a separate division under MOC called the Bureau of Standards and Quality Control. This will be strengthened to serve not only DOR, but also other departments within MOC. The central laboratory is currently only partly functional and only able to carry out simple routine testing of materials used in road works. While a fully operational independent central laboratory will provide some support to DOR's current works program, DOR should set up regional laboratories capable of carrying out all routine materials testing to support its maintenance programs.

## **IV. ACHIEVEMENT OF OTHER DEVELOPMENT IMPACTS**

### **A. Socioeconomic Impacts**

40. Road maintenance consists of two main operations: routine maintenance scheduled over short intervals to carry out small repairs, patching, and cleaning of drainage and side trenches; and periodic maintenance usually involving pavement resealing or resurfacing at intervals of 5-7 years. The physical components of the Project as envisaged at appraisal constitute periodic maintenance.

41. The economic evaluation carried out at appraisal was based on the general a priori merits usually ascribed to preventive maintenance. If carried out in a timely manner, maintenance would preclude more costly future repairs and premature reconstruction, which would mean potential savings in Government expenditures on roads. Another benefit was seen in reduced transport costs. However, given the low level of traffic on the project road, this aspect did not significantly contribute to the economic justification of the Project.

42. The economic internal rate of return (EIRR) of 45 percent at project appraisal confirmed the viability of the proposed interventions and the fact that the alternative of allowing deterioration to progress until full-fledged reconstruction became necessary would have been less economical. The PCR followed a similar line of reasoning, although many of the interventions actually carried out under the Project resembled those originally considered as

second best, e.g., intensive repairs and reconstruction. Nonetheless, the recalculated EIRR at project completion came close to that of appraisal mainly because the alternatives to a continued neglect of maintenance would, in its ultimate consequence, have led to a closure of the road and isolation of an entire region. Thus, the counterfactual scenario, the do-nothing alternative, would have entailed an exponential rise in economic losses, while exponentially rising benefits would have been attributable to the with-project situation.

43. The OEM confirms the economic rationale of the maintenance interventions under the Project, but considers that the evaluation approach adopted by the appraisal and PCR missions was somewhat misguided. The OEM's concerns are discussed in more detail in Appendix 5. Both the Appraisal Report and the PCR focused on the intrinsic merits of maintenance and produced results that could have been expected without elaborate analysis. The key factors in maintenance operations are appropriate timing and the cost-efficiency of the interventions. Neither the Appraisal Report nor the PCR have evaluated these factors. Developments during implementation have proved that the Project missed the optimal point of intervention. When the civil works started, the road had deteriorated so much that extensive preparatory work was necessary before the planned maintenance work. The Appraisal Report did not evaluate the comparative merits of other intervention options. Reconstruction was ruled out because of the loan amount, although it may be assumed that reconstruction on selected sections would have yielded high economic returns given the advanced state of deterioration on those sections.

44. The improved road conditions have benefited users of the project roads with faster travel and more reliable public transport, and for vehicle owners, lower vehicle operating costs. Cost savings for bus companies have not been passed on to the public because the Government sets bus fares at standard rates throughout the country. Lack of comparative data prevents an assessment of the impact of the road improvements on freight rates and other socioeconomic aspects.

45. The Project did not have any specific component to promote women's development. However, as road works in Bhutan use women laborers for many supportive tasks, the Project contributed to the employment of women and to increased household incomes. Other than that, there were no notable impacts specific to women; women benefit as part of the general road user population.

## **B. Environmental Impacts**

46. The Project utilized the existing road alignment so that land acquisition was not required. There were thus no issues of resettlement or major change to existing settlements. There were improvements in drainage and a decrease in dust pollution commensurate with this type of road rehabilitation.

47. However, finding cost-effective solutions to the disposal of debris resulting from widening curves and landslides continues to be a problem. The option of hauling the debris to predetermined sites in valleys is costly. But even if this option was affordable, the resulting truck traffic would damage the pavement, cause serious safety hazards to other road users and cause a loss of farm land or forest areas at the dumping sites. Where debris from hillside dump falls directly into rivers, attempts should be made to limit the damage by constructing retaining

walls at the river bank or move the debris to nearby hillsides where the environmental impact will be less severe. Measures should be taken to avoid causing further landslides and to protect the forest as far as possible in areas of dumping.

48. The use of firewood for heating bitumen is depleting valuable forest resources along the road. This could be reduced or eliminated by the use of oil-fired bitumen kettles and the use of cold mix for patching road surfaces.

49. Traffic safety will be considerably enhanced by DOR's current program of straightening and widening road curves. The construction of masonry barriers or steel guard rails on sharp curves and narrow road platforms should be prioritized.

50. Overloading of trucks was observed frequently on the western section of the project road. Axle loads are currently controlled only at the southern border. Control of logging trucks operating within the country needs to be enhanced.

51. Warning signs should be posted at the bottom of sections subject to closure due to landslides or snow. This would supplement the current system of broadcasting such closures over the radio.

### **C. Impacts on Institutions and Policy**

52. The measures chosen under the Project to improve institutions and policies for the road transport sector had the following impact:

- (i) The introduction of road maintenance management was unsuccessful. The only impact it had was that it heightened DOR's awareness of the necessity of systematically monitoring road conditions and scheduling maintenance interventions accordingly. However, DOR still lacks qualified staff to systematically collect and update data on pavement conditions, and the Project has had a marginal impact on this.
- (ii) DOR's skills in contract management have been strengthened under the Project. But the number of staff available to manage contracts and supervise civil works is insufficient.
- (iii) The Project has supported the Government policy of transforming DOR into a supervisory body and of delegating traditional DOR functions to the private sector. The Project provided an initial impetus to developing a fledgling contracting industry.
- (iv) Through policy dialogue, the Project attempted to increase the level of cost-recovery and the budget allocations to road maintenance. While cost recovery remains elusive, some progress has been made on increasing the budget allocations for roads.



## **V. OVERALL ASSESSMENT**

53. The OEM attempted an overall assessment of the Project in the light of five criteria, i.e., relevance, efficacy, efficiency, sustainability, and institutional development. Weighted scores were assigned to each criterion (Table 1). The Project was rated successful.

### **A. Relevance**

54. The inclusion of the East-West Highway in ADB's country assistance plan was well justified, not only from an economic perspective but, more importantly, from the point of view of maintaining the country's integrity. Given the physical and institutional needs of this strategic sector, the Project, as conceived at appraisal and evaluated after seven years, was and still is highly relevant. Overall, the Project's rationale combining physical improvements with capacity building must be considered highly relevant, given the significance of the road involved and the Government's efforts to build up its institutional capacity to maintain roads.

### **B. Efficacy**

55. The Project as a whole has not fully achieved its objectives. The physical targets set at appraisal have only partly been met. However, the shift made during implementation to heavier maintenance intervention was generally consistent with the Project's aim of reducing the backlog of road repairs. The Project has provided an impetus to capacity building in the contracting industry. Institutional development of DOR has fallen significantly short of the objectives set at appraisal. Maintenance management has hardly progressed and construction supervision and contract management remain areas of concern.

### **C. Efficiency**

56. Efficiency is determined by the actual and expected project benefits in relation to the inputs provided by the Project. An accurate assessment of this criterion is problematic because of the lack of baseline data, the delays in project implementation that caused a shift in project scope, and the general difficulty of formulating a more verifiable counterfactual scenario. Nonetheless, given the absence of alternatives to the interventions adopted under the Project, a high economic return to the inputs can be taken for granted. It remains doubtful, however, whether the returns are optimal.

### **D. Sustainability**

57. Some of the physical interventions constituted reconstruction and drainage improvements to increase the life of the road pavement. Other interventions were designed to protect the pavement for a limited period that is now about to expire. Some of these sections are

showing signs of distress and their sustainability can only be ensured if another round of periodic maintenance follows soon. The sustainability of the institutional efforts hinge on DOR's and ADB's willingness and ability to continue the learning process that was started under the Project. The fact that ADB is in the process of following up with another assistance project to the road sector is reassuring.

## E. Institutional Development and Other Impacts

58. Institutional development is a learning process and in this respect the Project has laid a foundation for future efforts to build on. Other than providing important lessons to be learned and thus triggering a learning process, the Project has not noticeably promoted institutional development (para. 52).

## F. Overall Project Rating

**Table 1: Assessment of Overall Project Performance**

Criteria	Assessment	Rating (0-3)	Weight (%)	Weighted Rating
1. Relevance	Highly Relevant	3	20	0.60
2. Efficacy	Less Satisfactory	1	25	0.25
3. Efficiency	Efficient	2	25	0.50
4. Sustainability	Less Likely	1	15	0.15
5. Institutional Development and Other Development Impacts	Moderate	2	15	0.30
<b>Overall Rating</b>	<b>Successful</b>		<b>100</b>	<b>1.80</b>
Overall Rating: Highly successful (HS)      HS > 2.5      Less than successful (LS) $0.6 \leq LS < 1.6$ Successful (S) $1.6 \leq S \leq 2.5$ Unsuccessful (U) $U < 0.6$				

## G. Assessment of ADB and Borrower Performance

59. **Borrower Performance.** DOR's performance was satisfactory. DOR should, however, have accepted the cost of construction supervision as an inherent and essential component of project implementation. In trying to avoid this cost and insisting on grant financing, DOR contributed to the friction in project management that occurred during implementation. Improvements are necessary in DOR's maintenance of construction records and project accounting.

60. **ADB Performance.** ADB's country assistance plan treated the Project as a "one-off" intervention and did not provide for more sequenced and contiguous interventions in the road sector. The project design proved too rigid for Bhutanese conditions. The loan amount rather than the country's needs determined the design. However, ADB review missions responded

sensibly to the challenges that occurred during project implementation. In concentrating the loan funds on the road sections in most need of repair they contributed to making the interventions relatively successful. ADB's performance is therefore rated successful.

## **VI. ISSUES, LESSONS, AND FOLLOW-UP ACTIONS**

### **A. Key Issues for the Future**

61. Principal issues identified by the OEM include

- (i) The experience of the PCR has flagged the general issue of self-evaluation and the PCR's value as a learning tool. Many weaknesses in the design of the Project and its implementation were skirted or overlooked by the PCR.
- (ii) Road conditions in Bhutan tend to change quickly and unpredictably. These factors have rendered the recommendations of the feasibility study prematurely obsolete to some extent. The type of interventions represented straightforward maintenance work, for which a full-fledged feasibility study may not have been necessary. Detailed engineering just before the commencement of works may have sufficed.
- (iii) The fact that reconstruction was excluded from the original design, although its urgency was known at appraisal, raises the issue of who would have been in a better position than ADB to address the accumulating repair needs on this strategic road. This is a programming concern, which could have been dealt with by appropriately sequencing ADB's assistance if the loan amount could not have been increased in that particular year.
- (iv) It has been standard ADB practice to conduct economic evaluations for road maintenance projects. The issue is whether such an evaluation is required given the intrinsic merits of maintenance.
- (v) Efforts are under way to transform DOR into a regulatory agency and delegate its current operational functions to a still fledgling private sector. ADB supports this policy. However, its implementation at this stage of institutional and sectoral development should be examined more carefully. Given the general dearth of trained engineers in Bhutan, it is likely the private sector would recruit staff mainly from DOR. It is unclear who in DOR would regulate the industry if many of its skilled staff have migrated to the private sector.

### **B. Lessons Identified**

62. In a situation like in Bhutan, project designs need to provide flexibility during implementation. A design that included only three types of periodic maintenance interventions proved to be too rigid and impractical. In hindsight, a sector-type approach would have avoided many of the ad hoc adjustments and the confusion that arose from them. By dividing the work into subprojects and designing them on a rolling plan basis during implementation, the Project would have been less susceptible to the risks inherent in a rigid design.

63. The fact that reconstruction was excluded from the original design, although its urgency was known at appraisal, was driven more by the given loan amount than by needs. The strategic significance of the project road and the substantial backlog of repair work should have been ascertained during the country assistance plan process. A longer-term program rather than a “one-off” project should have ensued from this consideration.

64. ADB’s general policy of financing supervisory services from loan funds was not followed under the Project. ADB should stress the importance of professional construction supervision and insist on loan financing as this would help instill a desirable sense of ownership and responsibility in the executing agency.

65. The RMMS was introduced without adaptation to local conditions in a rigid approach to institutional development. It was not a success. While Bhutan needs an information system for the management of road maintenance, ADB in consultation with DOR should have exercised greater diligence in identifying the main design features of the system in the light of their suitability for the special conditions of Bhutan.

66. There are obvious intrinsic merits in the maintenance of assets, and the maintenance interventions under the Project were given an unnecessary economic justification. Given the largely unverifiable nature of the assumptions made, ADB should abandon the practice of such unnecessary economic analysis. The economic evaluation for road maintenance projects should focus on the timeliness and cost-effectiveness of the proposed interventions.

### **C. Follow-Up Actions**

67. The timing of the OEM was fortuitous. It took place just before the processing of a new East-West Highway project started. The dialogue that ensued between the concerned ADB projects division and the OEM was healthy. The OEM provided early feedback on its findings to ensure that they can be taken into account in designing the new project. The OEM has in the meantime had a number of opportunities to follow up on the lessons learned. No further follow-up action is required at this stage.

## APPENDIXES

<b>Number</b>	<b>Title</b>	<b>Page</b>	<b>Cited on (page, para.)</b>
1	Civil Works Accomplished	19	2,6
2	Project Costs and Financing	20	6,19
3	Comparison of Road Construction Costs	21	6,19
4	Performance Maintenance	24	9,31
5	Some Considerations on the Economic Evaluation of Road Maintenance Projects	26	12,43

## CIVIL WORKS ACCOMPLISHED

Section of Road		Total Length (km)	Surface Enrichment (km)	Single Surface Treatment <sup>a</sup> (km)	Double Surface Treatment and Reshaping <sup>b</sup> (km)	No Treatment Required (km)	Requiring Reconstruction (km)	Drainage Works (km)
Trashigang - Mongar (Km 3 - 88)	Appraisal	85.0	24.4	31.5	0.0	17.5	11.6	
	Actual	0.0						0.0
Mongar - Jakar (Km 88 - 279)	Appraisal	191.0	7.8	126.9	4.7	31.0	20.6	
	Actual	103.4	16.0	71.9	15.5			3.0
Jakar - Trongsa (Km 279 - 347)	Appraisal	68.0	5.3	45.2	0.0	10.5	7.0	
	Actual	36.7	2.2	34.5	0.0			2.8
Trongsa - Wangdue (Km 347 - 476)	Appraisal	129.0	14.5	64.9	12.2	22.4	15.0	
	Actual	88.6	14.0	65.0	9.6			9.1
Wangdue - Simtokha (Km 476 - 546)	Appraisal	73.0	38.0	20.8	0.5	9.4	4.3	
	Actual	30.0	15.0	12.7	2.3			10.0
<b>Totals (Including Excluded Sections) Appraisal</b>		<b>546.0</b>	<b>90.0</b>	<b>289.3</b>	<b>17.4</b>	<b>90.8</b>	<b>58.5</b>	
<b>Totals (for Resealing) Appraisal</b>		<b>396.7</b>	<b>90.0</b>	<b>289.3</b>	<b>17.4</b>			
<b>Actual</b>		<b>258.7</b>	<b>47.2</b>	<b>184.1</b>	<b>27.4</b>			<b>25.0</b>

km = kilometer

<sup>a</sup> Single chip resealing.

<sup>b</sup> Reshape and double chip seal.

Sources: Department of Roads and staff estimates.

## PROJECT COSTS AND FINANCING

**Table A2.1: Project Costs by Item (\$ million)**

Item	Appraisal (1993)			Actual (2000)			Actual vs. Appraisal (%)
	Foreign	Local	Total	Foreign	Local	Total	
Periodic Maintenance Works	3.59	0.89	4.48	4.42	1.12	5.54	123.7
Bridge Strengthening	0.09	0.05	0.14	0.07	0.00	0.07	50.0
Consulting Services	0.70	0.00	0.70	0.79	0.00	0.79	112.9
Project Management	0.00	0.17	0.17	0.00	0.06	0.06	35.3
Service Charge	0.20	0.00	0.20	0.06	0.00	0.06	30.0
Contingencies	0.63	0.18	0.81	0.00	0.00	0.00	0.00
<b>Total <sup>a</sup></b>	<b>5.21</b>	<b>1.30</b>	<b>6.51</b>	<b>5.33</b>	<b>1.18</b>	<b>6.52</b>	<b>100.2</b>

<sup>a</sup> Total amount may not add up due to rounding.

**Table A2.2: Project Financing (\$ million)**

Item	Appraisal (1993)			Actual (2000)			Actual vs. Appraisal (%)
	Foreign	Local	Total	Foreign	Local	Total	
ADB-financed	4.51	0.70	5.21	4.60	0.63	5.23	100.4
Japan Special Fund	0.70	0.00	0.70	0.74	0.00	0.74	105.7
Borrower-financed	0.00	0.60	0.60	0.00	0.55	0.55	91.7
<b>Total <sup>a</sup></b>	<b>5.21</b>	<b>1.30</b>	<b>6.51</b>	<b>5.33</b>	<b>1.18</b>	<b>6.52</b>	<b>100.2</b>

<sup>a</sup> Total amount may not add up due to rounding.

**Table A2:3 Project Expenditures by Year (\$ million), 1993-1998**

	1993	1994	1995	1996	1997	1998	Total
ADB-financed	0.00	0.57	0.86	1.20	2.21	0.39	5.23
Japan Special Fund <sup>a</sup>	0.00	0.28	0.22	0.17	0.07	0.00	0.74
Borrower-financed <sup>a</sup>	0.00	0.08	0.10	0.13	0.21	0.03	0.55
<b>Total</b>	<b>0.00</b>	<b>0.93</b>	<b>1.18</b>	<b>1.50</b>	<b>2.49</b>	<b>0.42</b>	<b>6.52</b>

<sup>a</sup> Mission estimates.

Sources: ADB Loan Financial Information System, Technical Assistance Information System, and staff estimates.

**COMPARISON OF ROAD CONSTRUCTION COSTS  
(APPRAISED VS ACTUAL)**

**Table A3.1: Road Construction Costs per Kilometer**

	<b>Appraisal</b>	<b>Actual</b>	<b>Actual vs. Appraisal (%)</b>
Cost of Civil Works (\$ million)	4.48	5.54	123.7
Road Length (km)	396	259	65.4
Cost Per Kilometer (\$/km)	11,313	21,390	189.1
Foreign Exchange Rate	31.44 <sup>a</sup>	34.82 <sup>b</sup>	110.8
Cost of Civil Works (Nu million)	141.01	201.76 <sup>b</sup>	143.1
Road Length (km)	396	259	65.4
Cost Per Kilometer (Nu/km)	356,082	779,019	218.8

km = kilometers.

<sup>a</sup> Based on Report and Recommendation of the President, Asian Development Bank, October 1993.

<sup>b</sup> Based on Project Completion Report of the Department of Roads, (Asian Development Bank loan for road maintenance: Nu 182,952,099, and the Royal Government of Bhutan: 18,813,722 at \$1=Nu 34.82).

Sources: Department of Roads and staff estimates.



**Table A3.2: Road Construction Costs by Type of Intervention**

Section			Totals	Surface	Single	Double	No Treatment	Requiring	Drainage
				Enrichment	Surface	Surface			
				(km)	Treatment <sup>a</sup>	Treatment and	Required (km)	(km)	Works
					(km)	Reshaping <sup>b</sup>			(km)
Trashigang - Mongar (Km 3 - 88)	Appraisal	km	85.0	24.4	31.5	0.0	17.5	11.6	85.0
	Actual	km	0.0						0.0
Mongar - Jakar (Km 88 - 279) East-West + Environmental Friendly	Appraisal	km	191.0	7.8	126.9	4.7	31.0	20.6	191.0
		\$		10,031	1,560,880	157,582			
		\$/km		1,286	12,300	33,528			
	Actual	km	103.4	16.0	71.9	15.5			103.4
		\$		572,000	577,277	256,458			107,250
Jakar - Trongsa (Km 279 - 347) Environmental Friendly + Welfare	Appraisal	km	68.0	5.3	45.2	0.0	10.5	7.0	68.0
		\$		6,818	591,582				
		\$/km		1,286	13,088				
	Actual	km	36.7	2.2	34.5	0.0			36.7
		\$		5,194	277,035				39,363
Trongsa - Wangdue (Km 347 - 476) Welfare +	Appraisal	km	129.0	14.5	64.9	12.2	22.4	15.0	129.0
		\$		18,647	849,418	409,042			
		\$/km		1,286	13,088	33,528			
	Actual	km	88.6	14.0	65.0	9.6			88.6
		\$		500,500	521,950	159,954			128,496
Wangdue - Simtokha (Km 476 - 546) Singye	Appraisal	km	73.0	38.0	20.8	0.5	9.4	4.3	73.0
		\$		48,868	272,232	16,764			
		\$/km		1,286	13,088	33,528			
	Actual	km	30.0	15.0	12.7	2.3			30.0
		\$		536,250	101,981	131,940			140,541
Totals	Appraisal	km	546.0	90.0	289.3	17.4	90.8	58.5	546.0
		\$	3,941,864	84,364	3,274,112	583,388			
		\$/km	7,220	1,286	13,088	33,528			
	Actual	km	258.7	47.2	184.1	27.4			258.7
		\$	4,056,189	1,613,944	1,478,243	548,352			415,650
		\$/km	15,679	34,215	8,030	20,013			16,659

km = kilometer

<sup>a</sup> Single chip resealing.

<sup>b</sup> Reshape and double chip reseal.

Sources: Department of Roads and staff estimates.

**Table A3.3: Estimation of Road Construction Costs per Kilometer**

Item	Unit	Bid rates <sup>a</sup>	Roughton <sup>a</sup>	Appraisal <sup>b</sup>	RNS <sup>a</sup>
Fog seal	\$/km		1,734	1,111	1,286
SBST: 10mm chips	\$/km	7,338			
Bitumen	\$/km	1,005	8,343	10,305	13,088
DBST: 10mm chips	\$/km	7,338			
20mm chips	\$/km	7,840			
Bitumen	\$/km	1,005	16,183	31,179	33,528
Deep patch to 225mm	\$/sq.m		9.3		13,020
	\$/km		32,668		
Shallow patch to 100mm	\$/sq.m		6.3	4.5	7.5
	\$/km		22,164		
Lined drain	\$/km				15,000
Lined Vee-drains (DOR rate)	\$/km		1,365		

DBST = double bitumen surface treatment, km = kilometer, m = meter, RNS = Road Transport Network Development Study, SBST = single bitumen surface treatment, sq. m. = square meter.

<sup>a</sup> excluding patching, reshaping: assuming road width = 3.5 m.

<sup>b</sup> SBST and DBST rates include patching, reshaping.

Source: Staff estimates.

## PERFORMANCE OF MAINTENANCE

1. The performance of the maintenance interventions was found to be varied. Since the actual locations of the interventions could not be provided to the Operations Evaluation Mission (OEM), an accurate determination of the performance of the project-maintained sections of road was hampered by the difficulty in differentiating sections of new sealing from the original pavement. An approximate assessment of the overall pavement condition based on the OEM's observations while driving over the road is given in the line diagram shown in this appendix. This diagram also shows the sections on which maintenance works were carried out, as reported in the project completion report prepared by the Department of Roads (DOR).

2. In the low altitude areas where aggressive freeze-thaw cycles are not experienced, the resealed pavement sections are generally holding up reasonably well. According to a study financed by the Asian Development Bank (ADB),<sup>1</sup> the pavement structure typically comprises a bitumen bound surface of up to 40 millimeter (mm) penetration macadam,<sup>2</sup> chip seal, or premix mat on a 250 to 300 mm base course of water-bound macadam.<sup>3</sup> No subbase layer was discerned, and the subgrade was found to vary from sandy clay to broken rock or bedrock. While this pavement structure is adequate where good granular subgrades are encountered, it is underdimensioned for the weaker clay subgrades, which would require a pavement thickness of at least 500 mm to carry the heavy axle loadings imposed by two-axle logging trucks.

3. This was quite clearly seen by the OEM's visual inspection of the road. Where subgrades were good, the road surface was in good condition with little discernible deterioration and the overall condition rating was "good." In areas of weaker subgrades, the surface had already started to crack. The worst sections showed more advanced cracking and frequent depressions associated with subgrade failure. Here the condition was rated "fair," "fair/poor," or "poor."

4. In the higher altitude areas, the pavement is subject to freeze-thaw cycles of varying severity. Where silty/clayey frost susceptible subgrades are encountered, which is in the majority of the mountain sections,<sup>4</sup> a good subbase layer of adequate thickness is required to prevent softening of the subgrade under heavy axle loadings. In these sections, reconstruction is required as recommended in the report of the ADB-financed study. Some sections of the road in high altitude areas had been resurfaced under the Project and the pavements were in fair condition with an even surface profile and few signs of deterioration. These sections occurred in areas with hard bedrock formations, where the quality subgrades is usually good.

5. The higher altitude sections are also the most prone to landslides, and where landslides occur, the pavement is destroyed either through subsidence of the road platform or by the heavy equipment used to remove slide debris. DOR is currently undertaking extensive straightening and widening of road bends, which also involves heavy equipment. Until such sections have been stabilized or the widening works completed, pavements should be maintained as gravel surfaces by tractor-mounted graders.

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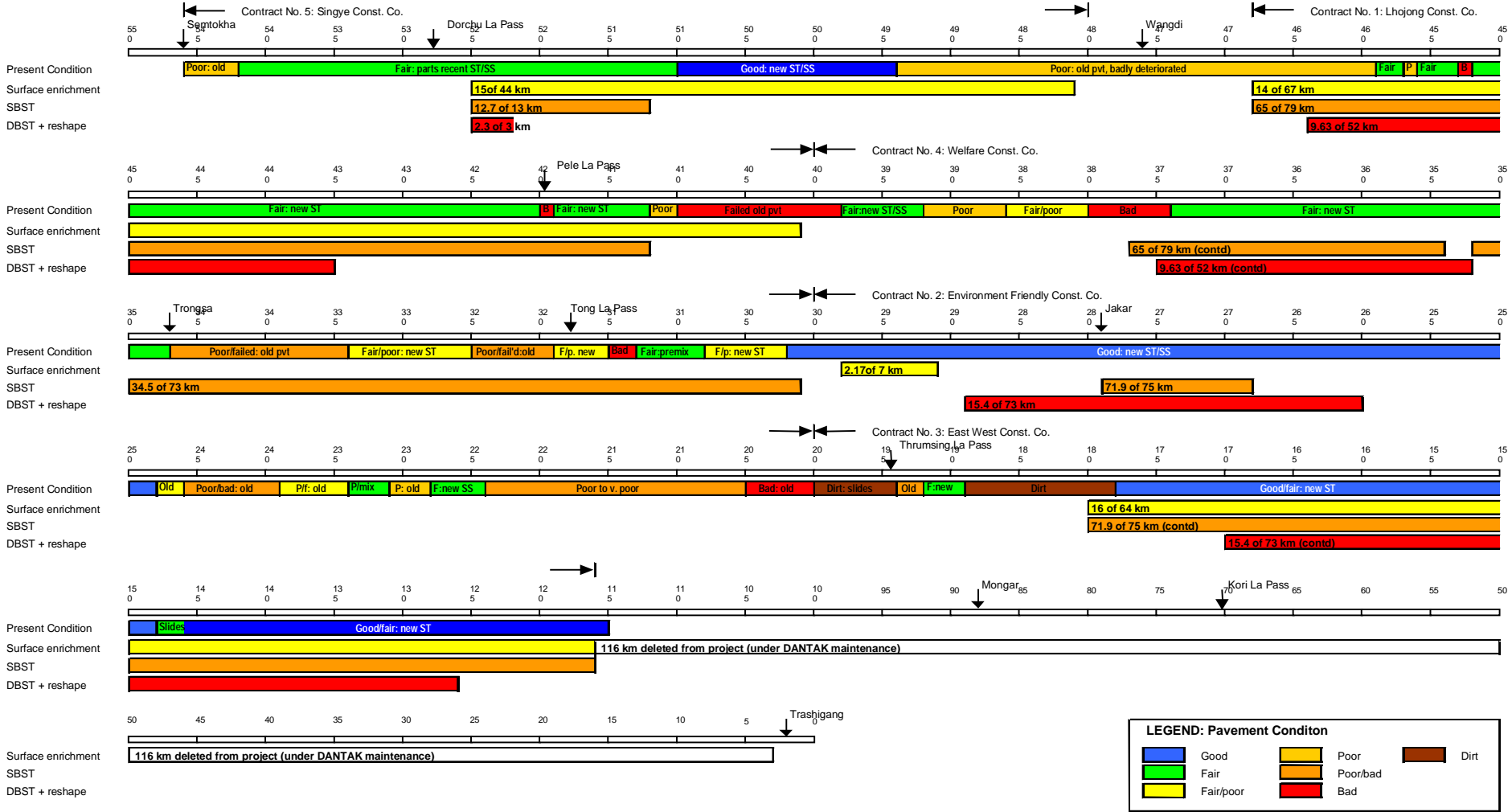
<sup>1</sup> TA 3107-BHU: *Road Transport Network Development*, for \$650,000, approved on 3 December 1998.

<sup>2</sup> Penetration macadam consists of 2 or 3 layers of progressively smaller, singular stones. Each layer is compacted by rolling, after which it is sprayed with hot bitumen, cutback bitumen or emulsified bitumen. Construction of penetration macadam, i.e., asphalt macadam, is well suited for labor intensive methods.

<sup>3</sup> The water-bound macadam base was built up of cobble to gravel sized broken stone filled with clayey sand.

<sup>4</sup> In a few mountain sections, the subgrade soils were of good quality and the pavements were in good to fair condition.

# LINE DIAGRAM OF CIVIL WORKS COMPLETED



## **SOME CONSIDERATIONS ON THE ECONOMIC EVALUATION OF ROAD MAINTENANCE PROJECTS**

1. Road maintenance consists of two main operations: routine maintenance scheduled over short intervals to carry out small repairs, patching, and cleaning of drainage and side trenches; and periodic maintenance usually involving resealing or resurfacing of the pavement at intervals of 5-7 years. The physical components of the Project as envisaged at appraisal constitute periodic maintenance.

2. The logic inherent in any asset maintenance is to preserve an asset's value as long as possible within a defined period usually considered as the asset's economically useful life. The underlying assumption is that maintenance precludes more costly repairs, reconstruction, or premature replacement. The merits of this assumption are universally accepted. Nonetheless, it has been standard practice in the Asian Development Bank (ADB) to validate this assumption by conducting an economic evaluation. The evaluation would typically focus on a comparison between the "do-nothing" alternative and the "with-project scenario" of a well-maintained road. The appraisal and the project completion review missions adopted this approach.

3. The heavy expenditures incurred on periodic maintenance are expected to generate returns through the avoidance of more costly repairs, reconstruction, or premature replacement. The expenditures are treated as an investment and subjected to the test of economic viability. Looking at it from an accounting perspective, expenditures for maintenance, whether for routine or periodic, are costs and not investments. As a cost item, they are recorded in the profit and loss statement, in contrast to an investment that would be added to the assets in the balance sheet. This is a formal concern about ADB's current evaluation practice.

4. A more substantive concern is related to the tautological manner in which the benefits for this Project are derived. A conventional economic analysis of maintenance benefits on a road with such low traffic relies heavily on maintenance savings. The economic evaluation carried out at appraisal was based on the general a priori merits usually ascribed to preventive maintenance. If carried out in a timely manner, maintenance precludes more costly future repairs and premature reconstruction, cutting down Government expenditure on roads. The counterfactual assumption would be that the Government would allow progressive road deterioration to occur, but would at a later stage be willing to spend relatively more in order to avoid a complete closure of the road. Clearly, this assumption implies irrational behavior of the Government and its relevance appears doubtful. Another concern is that the assumption cannot be verified or tested. However, without this assumption the only possible scenario would be to allow the road to deteriorate to a state where it becomes unserviceable. In the case of the project road as the only means of transport in the region, the economic losses resulting from this do-nothing alternative would be enormous and would rise exponentially and so would be the economic benefits attributable to the with-project scenario.

5. Economic evaluation must be based on a comparison of realistic options. It is doubtful that the alternatives examined by the appraisal and PCR missions were relevant in this sense. The economic internal rate of return of 45 percent at project appraisal confirmed the viability of the proposed interventions and that the alternative of allowing deterioration to progress until full-fledged reconstruction became necessary would have been less economical. The PCR followed a similar line of reasoning, although many of the interventions actually carried out under the

Project resembled those originally considered as second best, e.g., intensive repairs and reconstruction. Nonetheless, the recalculated EIRR at project completion came close to that of appraisal mainly because the alternatives to a continued neglect of maintenance would, in its ultimate consequence, have led to a closure of the road and isolation of an entire region. Thus, the counterfactual scenario, the do-nothing alternative, would have entailed an exponential rise in economic losses, while exponentially rising benefits would have been attributable to the with-project situation.

6. The key factors in maintenance operations are appropriate timing and cost-efficiency of the interventions. Neither the Appraisal Report nor the Project Completion Report have evaluated these factors. Developments during implementation proved that the Project had missed the optimal point of intervention. When the civil works started, the road deterioration had progressed so much that extensive preparatory work became necessary before the actual maintenance treatment could be applied. The Appraisal Report did not evaluate the comparative merits of other intervention options. Reconstruction was ruled out because of the loan amount, although it may be assumed that reconstruction on selected sections would have yielded high economic returns given the advanced state of deterioration on those sections.