PPA:INO 17014

ASIAN DEVELOPMENT BANK

PROJECT PERFORMANCE AUDIT REPORT

ON THE

SEVENTH ROAD (SECTOR) PROJECT
(Loan No. 692-INO)

IN

INDONESIA

May 1996

CURRENCY EQUIVALENTS

Currency Unit - Rupiah (Rp)

		At Appraisal	At Project Completion	At Postevaluation
$1.00	=	Rp1027	Rp1,992	Rp2,150
Rp1,000	=	$0.974	$0.502	$0.465

ABBREVIATIONS

AADT	-	Average Annual Daily Traffic
BAPPENAS	-	National Development Planning Agency
BINTEK	-	Engineering Directorate of DGH
BMS	-	Bridge Management System
CWU	-	Central Weighbridge Unit
DGH	-	Directorate General of Highways or Bina Marga
DGLC	-	Directorate General of Land Communications
Dinas LLAJ	-	Road Traffic and Transport Unit
DPUK	-	Kabupaten/Kotamadya Public Works Office
DPUP	-	Provincial Public Works Services
EIRR	-	Economic Internal Rate of Return
ESA	-	Equivalent Standard Axle (Weight)
IDC	-	interest during construction
IRI	-	International Roughness Index
IRMS	-	Integrated Road Management System
MPW	-	Ministry of Public Works
NPV	-	Net Present Value
OCR	-	Ordinary Capital Resources
PCR	-	Project Completion Report
PMO	-	Project Management Office
PPAR	-	Project Performance Audit Report
RBO	-	Regional Betterment Office
Repelita	-	Five-year Development Plan
SFED	-	Simplified Final Engineering Design
VOC	-	Vehicle Operating Cost

NOTES

(i) The fiscal year (FY) of the Government ends on 31 March.
(ii) In this Report, "$" refers to US dollars.

GLOSSARY

Bridge Management System (BMS). A computer-based system in the Directorate General of Highways (DGH) which records all national bridge requirements and provides estimates of the progressive investment in new bridges and the upgrading of existing bridges based on traffic estimates, unit costs and economic internal rates of return.

Integrated Road Management System (IRMS). A system developed by DGH with World Bank assistance to provide for computer-based national planning of periodic road maintenance and the estimation of the costs of upgrading, based on local requirements, contractor unit costs and economic internal rates of return.

Periodic Road Maintenance. Maintenance activities which are undertaken on a planned cyclical basis and involves the resealing of bitumen surface roads, the regraveling of gravel surface roads or the repairing or replacing of concrete pavements.

Road Betterment. Upgrading, by strengthening, resurfacing and widening of national and provincial roads where primary improvements are made to the existing road pavement, with little or no realignment or reductions in gradients. Minimum environmental and socioeconomic disturbance at the community level is an important secondary benefit.

Routine Road Maintenance. Maintenance activities which involve the year-round upkeep of the road pavements, the road shoulders and the related side drains and culverts, by grading, weeding, grass cutting, removal of flood debris, pot hole patching, sealing of cracks in bitumen and concrete running surfaces, repairing ground rails or safety markers and replacing minor bridge items.

Simplified Final Engineering Design (SFED). A DGH-developed fast-track approach to the design of road upgrading, whereby initial estimates of pavement upgrading requirements are determined and then after the funding is procured and contractors are mobilized, detailed design and implementation requirements are revised and re-specified.

CONTENTS

BASIC PROJECT DATA
Seventh Road (Sector) Project
(Loan No. 692-INO)

PROJECT PREPARATION/INSTITUTION BUILDING:

TA No.	TA Project Name	Type	Person-months	Amount	Approval Date
467-INO	Arterial, Collection and Rural Roads Project	PP	42	$150,000	29 June 1982
583-INO	Seventh Road Sector	PP	8	$36,000	20 January 1984

KEY PROJECT DATA ($ million):	Loan Documents	Actual
Total Project Cost	159.20	143.44
Foreign Currency Cost	95.00	84.57
Bank Loan Amount/Utilization	95.00	90.57
Bank Loan/Cancellation	—	4.43

KEY DATES:	Expected	Actual
Appraisal		29 May-13 June 1984
Loan Negotiations		9-10 August 1984
Board Approval		18 September 1984
Loan Agreement		3 October 1984
Loan Effectivity	2 January 1985	19 November 1984
Project Completion	31 December 1989	31 December 1991
Loan Closing	30 June 1990	4 June 1992
Months (Effectivity to Completion)	60	85

KEY PERFORMANCE INDICATORS (%):	Appraisal	PCR	PPAR
Economic Internal Rate of Return (EIRR)	not calculated[a]	61[b]	20-58

BORROWER : Republic of Indonesia

EXECUTING AGENCY : Directorate General of Highways

MISSION DATA:

Type of Mission	No. of Missions	Person-days
Fact Finding	1	30
Appraisal	1	80
Project Administration		
- Review	8 [c]	194
- Special Project Administration	3 [c]	45
- Project Completion	1 [c]	60
Postevaluation	1	16

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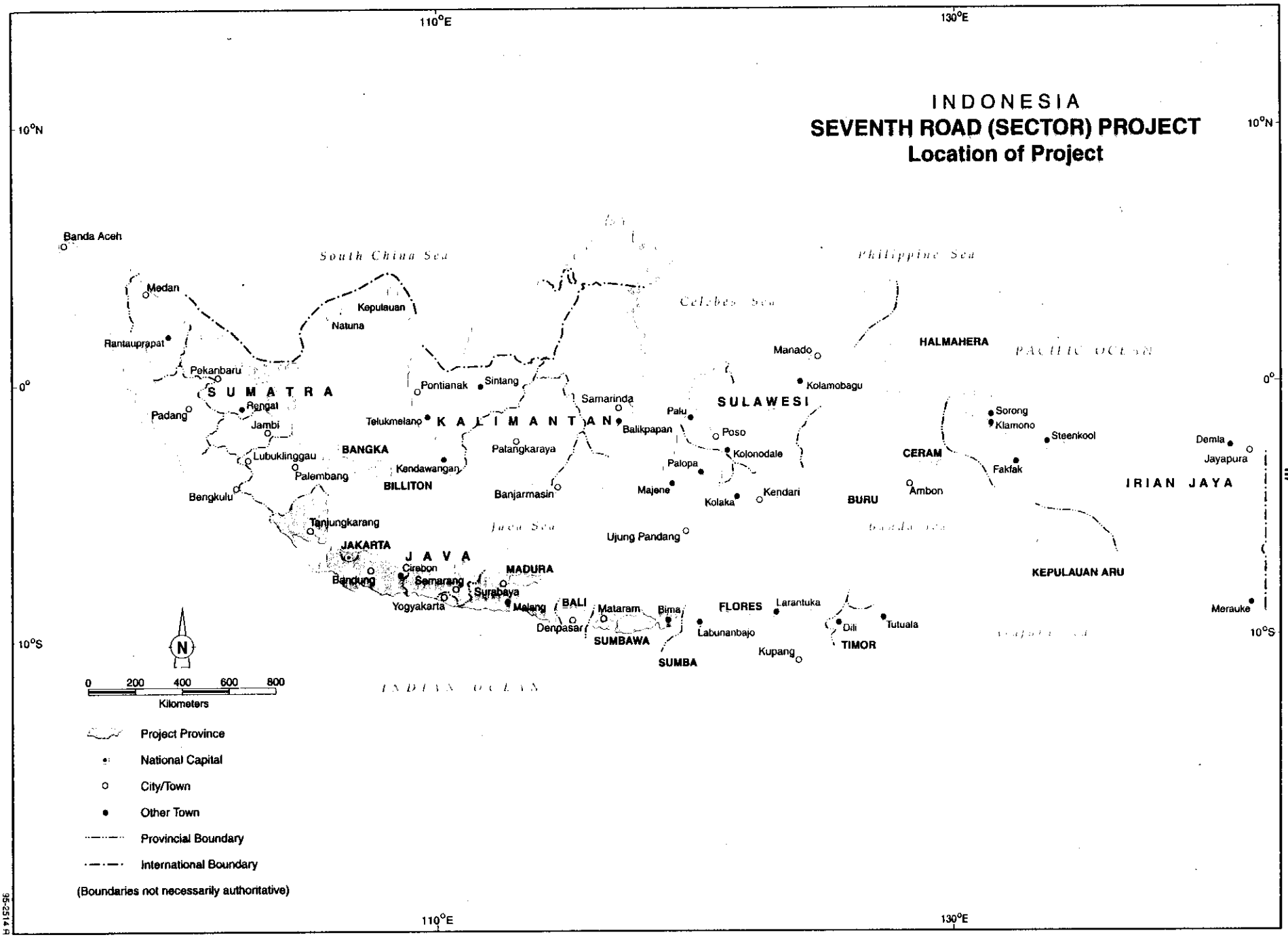
[a] The Appraisal Report stipulated a minimum EIRR of 12 percent for each road link to be improved.
[b] Based on 35 of the 61 links improved under the Project.
[c] Conducted in conjunction with missions for other projects.


INDONESIA
SEVENTH ROAD (SECTOR) PROJECT
Location of Project
110°E
130°E
10°N
0°
10°S
Banda Aceh
South China Sea
Philippine Sea
Celebes Sea
Medan
Kepulauan Natuna
Rantauprapat
Pekanbaru
SUMATRA
Padang
Bengkulu
Jambi
Lubuklinggau
Palembang
BANGKA
BILLITON
Pontianak
Sintang
KALIMANTAN
Telukmelano
Kendawangan
Palangkaraya
Banjarmasin
Samarinda
Balikpapan
Manado
HALMAHERA
Kolamobagu
SULAWESI
Palu
Poso
Kolonodale
Palopa
Majene
Kolaka
Kendari
PACIFIC OCEAN
Sorong
Klamono
Steenkool
Demla
Jayapura
CERAM
Fakfak
Ambon
BURU
IRIAN JAYA
Tanjungkarang
Java Sea
Ujung Pandang
Banda Sea
JAKARTA
JAVA
Cirebon
Bandung
Semarang
MADURA
Surabaya
Yogyakarta
Malang
BALI
Denpasar
Mataram
Bima
SUMBAWA
FLORES
Larantuka
Labunanbajo
SUMBA
Kupang
Dili
Tutuala
TIMOR
KEPULAUAN ARU
Merauke
Arafura Sea
INDIAN OCEAN
N
0 200 400 600 800
Kilometers
Project Province
National Capital
City/Town
Other Town
Provincial Boundary
International Boundary
(Boundaries not necessarily authoritative)
96-2514

I. HIGHLIGHTS

1. **Objectives and Scope**. The Project was aimed at supporting the Government of Indonesia's development programs in the roads subsector under the Fourth Development Plan (Repelita IV). The Project was to assist in the upgrading of high priority national and provincial road links, in improving road maintenance, and in strengthening institutions. The scope of the Project included: (i) upgrading approximately 900 kilometers (km) of national and provincial roads in the provinces of Lampung, West Java, Central Java, Yogyakarta, East Java, and West Nusa Tenggara; and (ii) procuring workshop equipment and tools, spare parts for road maintenance equipment, radio communications equipment, and traffic counters. The original scope of works was expanded to include an additional 466 km because of cost savings.

2. **Cost and Financing**. The final cost of the Project was $143.44 million compared with the cost estimate at appraisal of $159.20 million. The actual financing from the Bank from the ordinary capital resources (OCR) amounted to $90.57 million, compared with the original loan of $95.00 million, of which $4.43 million were canceled.

3. **Implementation Arrangements and Schedule**. The Directorate General of Highways (DGH) was the Executing Agency. It established Project Management Offices (PMOs) in each of the provinces. The Project was also supported by DGH's Regional Betterment Offices (RBOs) in Bandung, Semarang, and Surabaya. The Project was completed in December 1991, two years later than envisaged at appraisal. The initial delay of nine months was caused by the long time taken to prequalify local contractors; subsequently, the physical expansion in scope necessitated an extension of the completion date of the Project.

4. **Institutional Aspects**. The Project provided the Provincial Public Works Services (DPUPs) with experience in the design and the supervision of important road betterment works. Local consultants and DGH regional staff also gained experience with DGH's computer-based Integrated Road Management System (IRMS) and Bridge Management System (BMS) facilities, and with the Simplified Final Engineering Design (SFED) approach.

5. **Environmental Impact**. The direct environmental impacts of the roads were generally minimal because the roads that were improved followed the existing alignments with limited earthworks on the realigned sections. Land acquisition was limited and no buildings or vegetation was removed.

6. **Cost/Benefit Assessment**. The reestimated economic internal rates of return (EIRR) for a representative sample of links improved under the Project ranged from 20 percent to 58 percent. The economic benefits attributable to the Project consisted of savings in vehicle operating costs (VOC) and avoided maintenance costs. These benefits have been estimated by comparing the operating and maintenance costs "without the Project" and "with the Project" taking into account the induced changes in surface conditions and vehicle speeds.

7. The Project has also resulted in unquantifiable socioeconomic benefits at the regional and provincial levels. These include improving the quality of life of rural residents by improving transport services and access to other cities. The improvements in interurban bus services have been a major change in the transport sector because of the better running surfaces as a result of the Project. The island of Java is now well-serviced with a modern bus fleet, capable of providing rapid and comfortable transportation. The burgeoning tourism

industry on Java, in particular, has benefitted substantially from the development of the bus industry.

8. **Overall Performance and Sustainability**. The Project has achieved its primary objectives of upgrading important national and provincial road links. In addition, institutions at the provincial level have been strengthened by "hands-on" involvement in design and contract supervision.

9. Based on the actual growth of vehicle traffic, the general high quality of road construction, the satisfactory status of road maintenance workshops and equipment, and the increase in expertise of DGH and DPUP at the provincial level, it is likely that the benefits of the Project will be sustainable. However, this also depends on the satisfactory resolution of the emerging problem of truck and bus overloading. DGH is aware of the problem and plans to improve weight enforcement procedures based on an expanded weight bridge system. Based on overall performance and sustainability, the Project has been rated as generally successful.

10. **Feedback**. The experience of the Project demonstrates the importance of adequate road maintenance based on appropriate training of field personnel and providing adequate equipment, backed up by satisfactory workshop facilities. Further training of regional staff is required to ensure that the expanded road network is maintained. The Project highlights the importance of enforcing vehicle weight restrictions for trucks and buses. If the overloading problem is not reduced, DGH may have to modify their design standards. Accurate accident data need to be maintained and updated to identify where serious accidents have occurred. DGH's simplified engineering design procedure has been an effective way of rapidly upgrading roads in rural areas, despite the problems of limited background data.

II. BACKGROUND

A. Rationale

11. The Fourth Development Plan (Repelita IV), covering the period 1984-1985 to 1988-1989, recognized that the upgrading of high priority national and provincial roads throughout Indonesia was important. It also recognized that efficient road maintenance operations at the provincial level were critical to sustaining the expanding road network. Earlier Repelitas, particularly Repelita II, had achieved significant progress in reversing the deterioration in the road systems. Hence, the primary focus under Repelita IV was on upgrading roads at the provincial level. Road betterment had become an accepted approach to investment in road infrastructure. The road transport goals of Repelita IV were explicit and the Project, as appraised and implemented, received unambiguous support of the Government. In line with the earlier lending by the Bank for the road sector, it was expected that overall economic returns to maintenance or betterment would be satisfactory.

B. Formulation

12. The Project was the seventh loan for roads to Indonesia. It was formulated during 1984 in conjunction with the implementation of the Bank's Sixth Road Project.[1] The Bank also provided technical assistance[2] to support the preparation of the sector plans for the

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1 Loan No. 575-INO, for $60 million, approved on June 1982.

2 TA No. 467-INO: *Arterial, Collector and Rural Roads Development*, for $150,000, approved on 29 June 1982 in conjunction with Loan No. 575-INO.

improvement of national and provincial roads in six provinces throughout Indonesia under Repelita IV. A separate small-scale TA[1] for the Project was also provided to assess the spare parts required to support the road maintenance equipment and workshop equipment required for the future maintenance of the roads.

C. Objectives and Scope

13. The Project was aimed at supporting development programs in the roads subsector under Repelita IV. The Project was to support the upgrading of high priority national and provincial road links, contribute towards improving road maintenance, and provide institutional support. The scope of the Project included: (i) improving approximately 900 km of national and provincial roads in the provinces of Lampung, West Java, Central Java, Yogyakarta, East Java, and West Nusa Tenggara; (ii) procuring workshop equipment and tools, spare parts for road maintenance equipment, radio communications equipment, and traffic counters; and (iii) providing institutional support to the regional offices involved in the Project by providing consultants for field supervision and on-the-job training.

14. Because of the significant reductions in the bid prices for the civil works contracts, cost savings of approximately $38.6 million were achieved. The Bank subsequently approved an expansion of the scope of the Project, to include the upgrading of an additional 466 km of roads. After the completion of the additional works, a further $15.8 million in cost savings were achieved.

D. Financing Arrangements

15. The total cost of the Project was estimated to be $159.2 million at appraisal, including a foreign exchange component of $95.0 million and local currency cost of $64.2 million. The Bank's loan of $95.0 million from OCR was to cover most of the foreign exchange components. The terms of the loan included a repayment period of 25 years with a grace period of five years.

E. Completion

16. At appraisal, it was envisaged that the implementation of the Project would take over five years. A total of 1,666 km were finally upgraded, involving 36 different subprojects. Total upgrading represented approximately 2.3 percent of the total national and provincial road network of 69,239.1 km (see Appendix 1). The actual completion took about seven years including one extension of the loan to allow for the completion of additional works, made possible by the loan savings. The Project Completion Report (PCR), which was prepared by the former Infrastructure Department during November 1992, contains a detailed chronology of the Project. The nature of the time overruns can be readily identified. The quality of the PCR was satisfactory. However, details of vehicle use and discussion of the emerging problems of road safety and vehicle overloading were limited. The conclusions and recommendations were timely and relevant, particularly in relation to the scheduling of maintenance works and the need for additional training for DGH and DPUP personnel in mixing and laying asphalt.

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[1] TA No. 583-INO: *Seventh Road Sector*, for $36,000, approved on 30 January 1984.

F. Postevaluation

17. The Project Performance Audit Report (PPAR) presents the major findings of a Postevaluation Mission (PEM) that visited the areas covered by the Project from 30 November - 17 December 1994 and inspected most of the road links. A total of 2,800 km were covered in all six provinces. It is also based on a review of the Bank's documentation including the PCR, the AR, consultant's TA reports, and information provided by the personnel of DGH and the provincial DPUPs. The PPAR assesses the effectiveness of the Project in achieving its objectives, as defined at appraisal. Several key issues are also addressed.

18. Copies of the draft PPAR were provided to the Government, the Executing Agency (DGH) and Bank staff concerned for review and comments. The comments were considered in the preparation of the PPAR.

III. IMPLEMENTATION PERFORMANCE

A. Design

19. The conceptual design and approach to the road improvements envisaged at appraisal were closely followed. A bar chart of principal activities (appraisal versus actual) is in Appendix 2. At appraisal, it was planned that the specifications for civil works should be flexible to enable contractors to use different combinations of equipment and labor inputs to suit the work requirements throughout the six provinces. This approach was followed in the implementation of the Project with assistance from DGH's sophisticated computer-based IRMS[1] and BMS[2]. The improvement standards conformed with the Indonesian Highway Design Standards proposed at appraisal.

20. The detailed design and the development of tender documents for the roads and bridge works were prepared by the BINTEK (National Engineering Directorate of DGH) using the IRMS/BMS modules. An important design concept that followed the approach specified at appraisal was the SFED approach, which allows road pavement treatments to be determined rapidly, based on pavement stiffness (Benkelmen Beam estimates), International Roughness Index (IRI), width, annual average daily traffic (AADT), and the minimum EIRR (15 percent). These parameters can be determined quickly and make it possible to specify speedily pavement treatments on existing sections of roadways. This allows tenders to be called, based on general design concepts, and a schedule of contract rates to be developed. For the Project, the PCR noted the application of the SFED approach was marred by delays in the mobilization of technical staff of DGH in the early stages of construction, which nullified much of the initial time savings of this approach. Overall, the approach was beneficial, despite more difficult field conditions in some locations than initially assumed. A summary of the approach and how it can be applied in future projects is in Appendix 3. DGH has recognized that the field conditions under which the Project was implemented, were in many cases, quite different than expected and that field survey inputs were insufficient. These problems are being considered by DGH in their review of the application of SFED to new projects.

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[1] Developed with World Bank assistance.

[2] Developed with funding and technical support from Australian development assistance.

B. Contracting, Construction, and Commissioning

21. Given DGH's extensive in-house experience, the role of local and foreign consultants in the Project was limited. The role of the local consultants in preconstruction activities was limited to the design of specific road and bridge sections, and day-to-day contract administration. Specific international consulting inputs were required for contractor supervision. The work of the consultants was considered to be satisfactory. DGH personnel reported that the international consultants were able to provide useful training on-site. Quality control of specific aspects of contractor performance could have been tightened, if the international consultants had been given the authority to certify contractor payments and had been able to reject unsatisfactory works in progress.

22. All civil works were awarded under local competitive bidding. The performance of the local contractors was generally successful, despite several delays. These delays related to the prequalification of contractors. Subsequently, these Government procedures have been improved. There were a total of 36 contract packages, of which 8 were completed as scheduled; 19 were completed within six months of the original start date, and 5 within 12 months. Additional time beyond 12 months was required for three of the contracts. Only one contract was terminated because of poor performance. Field inspections during PEM support the PCR's view that most of the contractors' problems were logistical, and that the contractors were able to complete the contracts successfully, if the site was near their home base. Future prequalification should consider the capability of the local contractors to mobilize the appropriate equipment in a timely manner.

C. Organization and Management

23. The Executing Agency for the Project was DGH within the Ministry of Public Works (MPW). DGH is the road agency at the central or national level (see Appendix 4). It has the primary responsibility for the roads subsector at the national level, including the planning and programming of public roads and highways, designing and implementing most of the major road works,[1] and coordinating the rehabilitation, maintenance, and construction programs undertaken by the DPUPs. Under the decentralization policy of the Government, the responsibility for provincial and district roads has been increasingly delegated to the DPUPs and to the district public works departments (DPUKs), rather than DGH. Over the past decade, Indonesia has developed a comprehensive set of laws and regulations covering the planning, design, development, and maintenance of its roads network. DGH had a total staff of approximately 3,600 employees in December 1994, of whom about 750 were stationed in Jakarta. DGH estimated that approximately 250 Jakarta-based personnel and a further 1,200 provincial staff were involved in various aspects of the Project.

24. DGH established Project Management Offices (PMOs)[2] in each of the provinces as part of the Project. In addition, DGH's nine RBOs assisted in the design and the supervision of major projects. The RBOs also provided engineering support to the PMOs and coordinated with other Government agencies and the consultants. The PMOs were responsible to DGH through the central office of DGH.

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[1] The construction and operation of toll roads and expressways are the responsibility of PT Jasa Marga (Penseno), a government-owned company, established in March 1978.

[2] PMOs are located in Bandung, Semarang, and Surabaya.

D. Actual Cost and Financing

25. The Project was completed at a total cost (both foreign and local) of $143.44 million. A summary of appraisal versus actual costs is in Table 1. Based on the cost savings generated from the original scope of works and from the extended scope of works, it would appear that the original cost estimate at appraisal was overestimated. A more detailed breakdown of expenditure categories is in Appendix 5. The actual savings of $15.8 million were achieved despite the extended scope of works because of (i) the lower bid prices in civil works contracts, and a result of strong competition among local contractors in late 1987, when the national economy was in recession, and (ii) the devaluation of the rupiah from Rp1,027 to $1.00 at the time of appraisal to Rp1,992 to $1.00 by 1991.

Table 1: Project Financing Plan
Appraisal Versus Actual
($ million)

	At Appraisal			Actual		
	Foreign Cost	Local Cost	Total Cost	Foreign Cost	Local Cost	Total Cost
Bank	95.0[a]	- [b]	95.0	84.57[a]	6.00	90.57
Government	-	64.2	64.2	-	52.87	52.87
Total	95.0	64.2	159.2	84.57	58.87	143.44

[a] Included $16.50 million for interest during construction (IDC).
[b] Not planned at appraisal.

E. Implementation Schedule

26. The Project was finally completed on 31 December 1991, compared with the original schedule at appraisal of 31 December 1989. The delay was due largely to the change of scope to complete additional road upgrading works totalling 466 km, and the additional time required to prequalify local contractors. At appraisal, three months were allocated for the preparation of bid documents. The actual time required was 12 months. Thus, the annual schedule was underestimated at appraisal. Given that civil works were undertaken in six provinces, in relatively isolated locations, the implementation of the Project was generally efficient.

F. Technical Assistance

27. The Project was developed primarily from the Bank's ongoing work in the road sector and DGH's requirements, as specified in Repelita IV. Both the technical assistance grants, from the Bank, were regarded by DGH as useful. They initially funded assistance for road project planning as part of sector work and later funded experts to assist in survey work, in computer design modelling, and in identifying which regional depots would require additional equipment, spare parts, and technical training for field staff. They should have also examined the additional equipment required by the DPUPs for subsequent maintenance and the status of equipment and spare parts held by contractors in the rural areas.

G. Compliance with Loan Covenants

28. The performance of DGH has been generally satisfactory, in compliance with major loan covenants. Several minor omissions and delays were experienced in the submission of audited accounts in English, submission of Borrower reports, exchange of information about the Government's sector policies, and timely rehabilitation of bridges not covered by the Project. These were discussed with DGH. The submission of accounts in English was an issue that has been resolved by the employment of additional trained staff.

IV. PROJECT RESULTS

A. Operational Performance

29. The operational performance of the Project has been assessed primarily in terms of the volume of traffic carried and the technical impacts of the traffic on road pavements. Throughout all six provinces, growth in road traffic movements has averaged 6-7 percent per annum over the past decade. From 1991-1994, road traffic has been growing at a rapid pace and has increased by more than 10 percent on several road sections in Lampung, West Java, and Central Java. On three road links in West Nusa Tenggara, the average annual growth has exceeded 40 percent. The rapid growth in traffic reflects the steady growth of the Indonesian economy over the past years and the improvements in the roads that generated higher traffic. However, because of traffic diversions and slower economic activity in certain localities, the traffic counts on some road links for the period 1992-1994 were lower than in 1991 (see Appendix 6).

30. The average traffic levels on national roads are generally between 3,000 and 10,000 vehicles per day. In the major urban corridors of Java and in Lampung Province, the volumes have been higher. The primary growth has been in passenger vehicle traffic and in motorcycles. According to DGH, most of the trips are short and are stimulated by the improvements in running surfaces, as measured by the IRI.

31. Vehicle registration statistics reveal that the bus fleet has grown the most in West Java and the truck fleets in Lampung and East Java (see Appendix 7). This growth is a major source of future pavement maintenance requirements, for which appropriate cost-recovery policies are not in place yet. DGH has a permanent network of traffic counting stations covering all the roads under the Project. The data generated from the counting stations and the national weighbridge data are being examined now for evidence of axle overloading, and its impact on the road pavements. DGH is aware of the problems associated with overloading and pavement damage. Its nationwide system of traffic counting stations is slowly screening overloaded vehicles along specific corridors. Fines and license restrictions are being imposed on drivers whose vehicles exceed the weight limits determined by the weighbridges. The policing of overloading is expected to improve as the network of weighing stations is extended.

32. Since the completion of the Project, the PEM has determined from field inspections that DGH has achieved a satisfactory level of road maintenance for the components of the Project. The side drains have been kept clear, the grass has been cut regularly, and most "soft" spots have been repatched. Where road shoulders have been damaged, as a result of truck overloading, repairs have been generally undertaken within one

to two months of damage. DGH has still not been reimbursed from the fines for the costs associated with damage caused by overloading.

B. Institutional Performance

33. As a sector loan, this Project has enabled the personnel in DGH and DPUP in all six provinces to further develop their project design and implementation skills. In particular, the application of IRMS to 61 road links covered by 36 contract packages generated significant experience in DGH's head office, in the RBOs and in the provincial offices. The funding for the Project also included improvements in communications facilities at the local level and for workshop facilities to be upgraded and supported as required. The PEM found that the utilization of equipment and spare parts provided under the loan was satisfactory. Most of the offices of the DGH and DPUPs fully accounted for the equipment and spares and the vehicles and equipment were still operating satisfactorily.

34. DGH has benefited from the Project in terms of the additional technical training provided to its staff. Computer-aided design work is now widespread, training courses in overseas centers have been funded on a regular basis and office facilities and vehicles in all provinces are readily available and maintained at a generally high standard. Over the past decade, DGH has employed a wide range of technical experts to strengthen its institutional capability. The foreign consultants funded under the Project provided field supervision and assisted in the design and the preparation of specifications for contracts as well as conducted on-the-job training for DGH regional and provincial staff.

35. The PEM noted the apparent lack of coordination between DGH, which is responsible for planning and investment in new roads, and DPUPs/DPUKs, which implement the maintenance of national roads using funds channelled through DGH. Despite the legislative separation of responsibilities among the different agencies, several functions are still ambiguous. For example, the roles of DGH and the DPUPs individually and separately in assisting the district (kabupaten) roads remain unclear. For the Project, this resulted in minor delays during implementation when additional equipment was required. The PEM found several examples where maintenance equipment had been delivered to *kabupatens*, without the local staff being fully trained in the use and maintenance of the equipment.

36. Similarly, there is a need for closer coordination between DGH and the Road Traffic and Transport Units (Dinas LLAJ) of the Directorate General of Land Communication (DGLC) whose local units or Dinas LLAJ are responsible for providing road safety equipment and marking lines at the provincial level. Neither organization appeared to have satisfactorily resolved the issues of road painting and signs after reconstruction of the roads were completed. While Dinas LLAJ have the functional responsibilities, DGH offices have more mobile equipment and trained personnel available.

C. Economic Reevaluation

37. The reestimation of the EIRRs was based on the IRMS Model[1] of DGH and subsequently verified by the PEM by conducting an independent economic reevaluation of

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[1] DGH's IRMS facilities incorporate the World Bank's Highway Design Model (version III). The IRMS was relied upon by the Bank in formulating the Bank's Loan No. 1115-INO: *Eleventh Road (Sector) Project*, approved for $150 million in November 1991.

some of the road sections. The IRMS Model of DGH was used during appraisal in estimating the EIRRs for a subsample of 32 road packages. The Appraisal Report stipulated a minimum EIRR of 12 percent for each road link to be improved. The IRMS Model was also the basis for estimating the EIRR of the Project upon completion, which was 61 percent. The EIRRs of the completed road sections as estimated by DGH varied between 56 percent and 98 percent.

38. In verifying the results of the IRMS Model, the PEM conducted an independent economic reevaluation on three road links for which operational data were available. The economic analysis was undertaken by deducting transfer payments from the financial costs and by applying the appropriate conversion factor to arrive at the economic costs. The major economic benefits of the Project were quantified in terms of savings in VOC and avoided maintenance cost, by comparing the "without the Project" and "with the Project" situations. The economic costs and benefits of the Project have been valued in constant 1994 prices using manufacturers' unit value (MUV) index and gross domestic product (GDP) deflator for Indonesia. The economic life of the rehabilitated road sections was assumed to be 20 years with routine annual and periodic maintenance. The EIRRs ranged from 20 percent to 58 percent. A detailed summary of the results is presented in Appendix 8.

39. The PEM's estimates were lower than the estimates by the IRMS Model because the traffic growth projections in the IRMS Model as well as the assumption about the IRI coefficients were higher. Although the PEM's reestimates of the EIRR were lower, they confirmed that the Project has been generally successful in achieving its objectives.

D. Socioeconomic and Sociocultural Results

40. The Project has also resulted in significant but unquantifiable socioeconomic benefits at the regional and provincial levels. These included improvements in the quality of life of rural residents by providing transport services and access to other cities. The positive impacts indicated by residents in the provinces included (i) savings in travel time between centers; (ii) increase in community participation and cohesion; (iii) improved access to urbanized health care and education services; (iv) increase in small-scale industrialization, following an inflow of capital; and (v) increase in residential land values associated with improved access to transport services.

41. The improvements in interurban bus services have been the major change recently in the transport sector. The roads improved under the Project supported a modern bus fleet, capable of providing rapid and comfortable transportation. At the provincial level, investment in tourist resorts has been stimulated by the improved road access to new beach destinations along the west coast of Java, centered on Labuhan; in West Nusa Tenggara (Lombok), around Ampenan; and in West Nusa Tenggara (Sumbawa), centered on Huu. These developments in tourism, principally serviced by international-standard tourist buses, could not have been justified without the upgrading of the road pavement.

42. During the implementation of the Project, DGH estimated that more than 2,200 jobs were created during the peak period of the civil works throughout the six provinces, of which more than 1,600 persons were unskilled locally hired workers. This resulted in positive multiplier effects in those six provinces that have not been quantified.

E. Women in Development

43. The Project was not designed to have any gender-specific impacts. Field investigation during the PEM throughout the six provinces and discussions with DGH field staff have indicated that the improvements in the roads may have improved the status of women by (i) reducing the travel time by bus and tricycle from rural areas to urban center for access to health and commercial services, and (ii) improving access to educational and child care facilities.

F. Environmental Impacts and Control

44. Given that the rehabilitated roads followed the existing alignments and grades, with little or no earthworks to realign sections, the direct environmental impact of the Project was generally limited. There was little land acquisition and almost no removal of buildings or vegetation. Indonesia has developed a significant body of legislation to protect the environment. The Bank has been instrumental in assisting the Ministry of Public Works (MPW) in upgrading its capability to implement environmental regulations. DGH has benefited directly from the strengthening of environmental impact regulations, and has trained its staff to implement the environmental guidelines.

G. Gestation and Sustainability

45. Based on the actual growth of vehicle traffic, DGH's satisfactory road maintenance record since completion of the Project, the satisfactory status of road maintenance workshops and equipment, and the expertise of DGH and DPUP at the provincial level, it is likely that the benefits of the Project will be sustainable. In real terms, annual expenditure nationwide on road maintenance is increasing as a percentage of Government road expenditure and of total Government expenditure (see Appendix 9). The long-term sustainability of the Project, however, depends upon the satisfactory resolution of the emerging problem of vehicle overloading particularly by trucks. The technical quality of road works has improved gradually over the past decade. It has been supported by the computer-based IRMS and BMS models and the SFED approach. DGH's maintenance work program including engineering preparation, tender evaluation, quality control, and monitoring have now reached high technical standards. All periodic maintenance and rehabilitation improvement works are now carried out by private contractors. Standard contractor prequalification procedures and bidding and contract documents have been developed satisfactorily and are used nationwide. A "quality culture" has now become a reality through Java and is developing in West Nusa Tenggara. DGH, at the central level, has been largely instrumental in achieving this change in quality of construction and maintenance activities.

V. KEY ISSUES

A. Vehicle Overloading and Cost Recovery of Pavement Damage

46. Road user charges for the roads upgraded under the Project are not directly related to the financial costs required to maintain the roads and highways. On the roads where damage from overloading has occurred, the vehicle owners responsible have not been required to pay for the actual damage. Entry into the trucking industry is relatively inexpensive. The road transport fleet comprises 30 percent Government-owned vehicles, 45 percent driver-

owned, and 25 percent Government-owned corporations. Because the rates for truck hire are not regulated or gazetted, and vary according to route, availability of backloading, and type of commodity carried, competition is intense. The disincentives for overloading are minimal. The detection of overloaded vehicles is difficult because the road network in Indonesia is extensive. The enforcement of axle weight limits is also limited by the number of weight bridges and traffic officials. Overloading particularly by single dual-tire axle trucks is thus widespread, causing significant structural damage to the outer perimeter of the pavement. On the roads covered by the Project, damage was found in all six provinces. Central Java was the worst affected. The pavement damage from overloading is compounded if the roadside drainage is poor. However, the costs associated with the damage for repairs to the roads and to the vehicles have not been quantified and recovered from the trucking industry. The existing tollways provide only a limited opportunity for overloaded vehicles to be required to pay for their share of the costs associated with the repair of the pavement.

47. A detailed summary of the study on vehicle overloading, which was completed in 1992-1993, is in Appendix 10. For the sample of links surveyed under the Project, throughout the six provinces, overloading by trucks and buses was a significant problem (22 percent of all vehicles exceeded the ten-ton single axle weight limit). In Central Java, 38 percent of all vehicle movements exceeded the road pavement design limit.

48. These economic costs are not borne by the road transport industry because of the inefficient road user taxation system and more importantly, the inadequate enforcement of vehicle weights and diversions. The Government is aware of the enforcement problem. In the absence of a more comprehensive system of enforcement, DGH has proposed, as an alternative, that design standards be raised, particularly for the more remote provinces. DGH also recognizes that this would significantly increase capital costs, which the volume of traffic does not warrant. Now this is a second-best solution to the problem of inadequate cost recovery from the trucking industry.

49. The issues of cost recovery of capital and maintenance costs were not considered in any detail at the preparation or at the appraisal stage of the Project. The potential physical damage to road pavements and to bridges from overloaded trucks was not specifically addressed. This issue was not perceived as a risk for the Project, despite earlier warnings in earlier projects. It remains an issue and is highlighted as critical to the sustainability of the Project. A sensitivity analysis of the effect of (i) a reduction in VOC savings because of vehicle overloading, and (ii) lower VOC savings combined with no maintenance savings on the economic viability of the Project is in Appendix 8. The results indicate that although the estimated EIRRs would decrease, the Project remains viable. Nonetheless, the problem of pavement damage needs to be addressed by expanding the number of weighbridges to detect overloading. Stiffer fines for overloading also need to be enforced and the revenues turned over to DGH and to DPUPs to fund the required maintenance. Throughout the road transport industry, driver awareness programs need to be presented to make drivers/owners of heavy trucks aware of the economic costs and of the penalties to be imposed, if overloading is detected.

B. Road Safety

50. Road traffic accidents, both minor and serious, are a major concern on both the roads covered by the Project and the overall road network in Indonesia. However, detailed data are lacking at the provincial and at the national level. DGH estimates that in 1994 there

were approximately 12,000 fatalities and more than 55,000 serious injuries. By comparison, total fatalities were approximately 11,200 in 1991, and were 11,600 in 1992, an average annual growth rate of 3.5 percent over the three-year period. However, the average traffic growth rates over the network have exceeded 7 percent over the past three years. While the growth rate in the level of serious accidents has slowed recently,[1] it remains unacceptably high by international standards. Road betterment activities do not involve any significant changes in the alignment or in the vertical elevations in the road running surfaces. However, the subbase and the running surface and specific drainage channels are improved. Consequently, the increase in running speeds, has caused serious head-on collisions from overtaking and from running off the pavements. A requirement now is to invest in the installation of more guard railings, line markings, night reflective materials, and road warning signs. Danger warnings and speed restriction signs, if enforced by the police, can be effective in reducing road accidents. However, throughout rural Indonesia, this next stage of investment has not been made yet. Of particular concern is the lack of adequate communications facilities and ambulances to help accident victims. No agency has the clear responsibility for transporting accident victims. Additional funding for ambulances and patrol cars would appear to be a key future priority.

51. The Government has commenced a road safety "black spot" removal program, under which the most serious road accident locations are upgraded. However, the implementation of the program is hampered by a lack of detailed and systematic traffic accident data. The World Bank has assisted in the development of a comprehensive system of accident reporting and incident collation. However, implementation is slow, and the data on the provinces covered by Project outside Java are limited.

C. Road Maintenance

52. During the past decade, investment in roads in Indonesia has been focused primarily on upgrading the roads. The primary objective of this Project was to upgrade roads than construct additional road links. The country's annual road maintenance budgets have been low by international standards (at least 3 percent of total annual road investment). The absolute size and the growth of road maintenance expenditures over the period 1984/85 to 1993/94 is shown in Appendix 9. In real terms, actual road maintenance as a percentage of total expenditure has increased steadily from 1.4 percent in 1984/85 to 3.3 percent in 1993/94. This increase may be partially explained by the increase in total investment in roads, as a percentage of total expenditure from 9 percent in 1984/85 to almost 22 percent in 1993/94. Generally, the technical quality of road maintenance has also improved during the past decade. However, adequate road maintenance remains a critical issue for the road sector particularly at the provincial and local levels.

53. The maintenance of provincial and rural roads is normally carried out by the DPUPs, partly with provincial funds and partly with funds from the National Government. The priorities ascribed to maintenance works are determined at the provincial and local levels, while the funds to be committed are determined at the national level. It would appear that the allowances for the annual maintenance of the roads upgraded under the Project on a per km basis are adequate. Problems arise if the roads have not been built to satisfactory standards and additional maintenance expenditures are required subsequently. Road maintenance of the national and provincial roads is now largely undertaken by private contractors rather than by day laborers in the public sector. However, DGH has the overall responsibility to maintain

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[1] DGH assessment, December 1994.

pavement standards for national roads. In addition, there are still road sections, such as in difficult mountain areas, which are frequently affected by landslides, that require equipment from DGH and DPUP. However, adequate on-site supervision is still missing at the provincial and local levels to achieve satisfactory results with newer road paving materials such as graded aggregate paving materials, cold-mix asphalt, and fine-grain asbestos. Quality control is necessary to ensure that materials are correctly prepared and blended. The field staff of DGH and DPUP in many of the provinces need to be trained in the use of bituminous paving and prestressed concrete bridge construction techniques, under all types of conditions, to ensure adequate final quality.

54. Critical to the improvement in the quality of road maintenance works is the need to increase the efficiency of the contracting process. In particular, incentives such as longer duration contracts are necessary to allow contractors to invest in new equipment. The PEM noted this in West Nusa Tenggara Province (Sumbawa), in particular. Given the sustained growth in passenger traffic in specific corridors on Java at levels significantly higher than estimated at appraisal, periodic maintenance activities will need to be carefully monitored by DGH. This will require a strengthening of its provincial resources. Key specific items will continue to be (i) the adequacy of the technical support provided by contractors' workshops and the levels of skilled training provided to employees, and (ii) the stability of staffing of DGH and DPUPs at the provincial and local levels. DGH needs to monitor closely the movements of trained staff from the outer provinces and to seek guarantees from the local governments that trained staff remain in their positions for at least two years after training.

VI. CONCLUSIONS

A. Overall Assessment

55. Based on the PEM's findings, the Project is rated as generally successful. Most of the individual road sections have generated higher than originally estimated traffic flows and are expected to yield EIRRs between 20 percent and 58 percent, well above the minimum requirement of 12 percent stipulated at the time of appraisal. With a few exceptions, all of the rehabilitated roads remain in good physical condition. DGH has introduced satisfactory road maintenance practices that are designed to protect the integrity of the road pavement. The sustainability of the Project will depend on the continued adequately funded maintenance programs and on a reduction in the incidence of vehicle overloading. The overloading will require further careful scrutiny and satisfactory enforcement practices, which have not been introduced yet throughout all the six provinces. There is also a need to improve road safety levels in line with the improvements in road conditions.

B. Lessons Learned

56. The Project highlights the importance of adequate road maintenance, appropriate training of field personnel, and providing sufficient maintenance equipment, backed up by satisfactory workshop facilities. The Government has achieved significant progress in upgrading its road maintenance capabilities over the past decade based on the policy dialogue and assistance provided by the Bank for this and earlier projects in the road sector. Further field training of staff (DGH, DPUP, and contractors) is required to ensure that the latest techniques in applying asphalt materials are utilized.

57. The Project clearly demonstrates the importance of enforcing vehicle weight regulations particularly for the trucks. The design standards set by DGH have been appropriate for rural conditions, only if overloading is curtailed.

58. There is an urgent need to maintain and circulate up-to-date road accident statistics, particularly to identify where serious accidents have occurred. For the Project, it was not possible to identify the nature of the problem, on a road-by-road basis, because of the inadequate data base. The policy dialogue in relation to the rural roads in Indonesia should include the need to upgrade road accident data collection and analysis, on a network basis.

59. DGH's simplified engineering design procedure has been an effective way of determining road upgrading and has supported the rapid implementation of road upgrading in rural areas. The practice, however, could be further improved by ensuring that (i) adequate field data are assembled prior to commencement of SFED activities, (ii) sufficient time is scheduled for field surveys, (iii) experienced personnel are recruited, and (iv) contractors are required to complete all survey and testing activities within a specified period.

C. Follow-up Actions

1. By the Bank

60. The Bank should discontinue the practice of relying solely on DGH to generate the EIRRs for road links as part of Bank lending and project completion activities. The Bank should generate independent estimates of the EIRRs for all components of the Project with which it is involved.

61. The Bank should discuss further with DGH the importance of upgrading the road accident data collection and analysis procedures to identify the locations where serious accidents occur.

62. The Bank should follow up with DGH the desirability of incorporating in the prequalification documents for contractors their capability to mobilize equipment and plant.

2. By the Executing Agency

63. DGH should improve its traffic counting system and its estimation procedures for VOCs, including its estimates of IRIs for individual road links, before and after road upgrading. DGH also needs to further refine its IRMS and BMS modelling techniques after improving its primary data inputs.

64. DGH should be encouraged to provide additional training to technical staff employed by contractors, in relation to road maintenance techniques involving the more efficient methods of bituminous paving.

65. DGH should be encouraged to provide closer technical supervision of provincial road betterment projects, to ensure that detailed pavement design provisions are met and that the use of new materials such as bituminous paving and prestressed concrete bridge construction techniques is fully understood.

66. DGH should be encouraged to provide additional funding for road safety equipment such as signs, road markings, and roadside accident barriers to reduce serious road accidents.

APPENDIXES

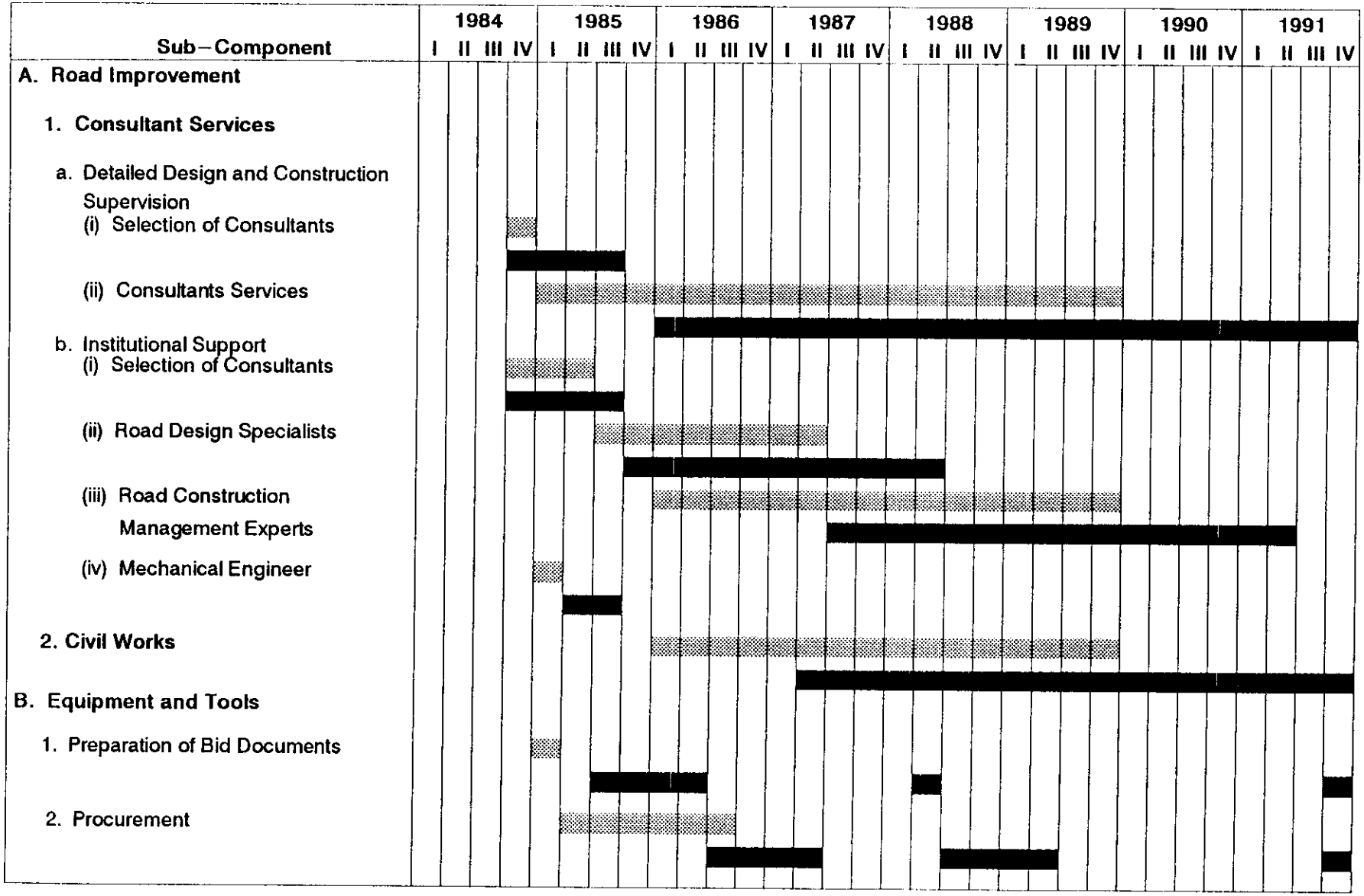
INDONESIA: PUBLIC ROAD NETWORK
(Administrative Classification)

Province	Road Network in Kilometers				Total
	National	Provincial	District	Municipal	
Aceh Special Region	1,162.3	2,024.2	7,141.4	470.5	10,798.4
North Sumatra	1,360.5	2,754.3	12,373.6	1,680.0	18,168.4
West Sumatra	898.0	1,472.9	8,142.5	1,657.6	12,171.0
Riau	906.4	1,607.4	5,440.5	846.0	8,800.3
Jambi	851.1	992.1	5,140.0	285.7	7,268.9
Bengkulu	750.4	921.6	2,749.4	534.7	4,956.1
South Sumatra	1,038.2	2,716.4	8,216.0	662.4	12,633.0
Lampung [a]	861.5	2,248.8	4,749.1	286.8	8,146.2
DKI Jakarta	153.5	1,097.9	0.0	4,840.8	6,092.2
West Java [a]	1,481.9	1,942.3	15,279.5	2,398.6	21,102.3
Central Java [a]	1,209.1	2,580.1	15,420.8	2,603.8	21,813.8
Yogyakarta [a]	158.4	638.5	3,357.7	298.5	4,453.1
East Java	1,641.8	2,000.8	17,242.0	2,432.5	23,317.1
West Kalimantan	1,016.1	1,885.2	6,497.3	400.1	9,798.7
Central Kalimantan	1,258.5	906.7	2,891.8	330.0	5,387.0
East Kalimantan	1,249.8	980.2	2,449.9	487.5	5,167.4
South Kalimantan	881.6	746.0	4,016.6	535.8	6,180.0
Bali	409.3	674.8	3,525.0	322.9	4,932.0
West Nusa Tenggara [a]	579.3	1,532.1	2,922.1	271.2	5,304.7
East Nusa Tenggara [a]	1,190.4	3,254.4	9,305.8	480.6	14,231.2
East Timor	581.0	861.1	2,439.4	419.1	4,300.6
North Sulawesi	1,379.0	916.7	4,841.0	463.4	7,600.1
Central Sulawesi	1,584.7	1,566.9	3,840.4	216.6	7,208.6
South Sulawesi	1,562.3	1,559.6	12,625.5	1,890.9	17,638.3
Southeast Sulawesi	611.7	1,178.6	5,285.4	433.0	7,508.7
Maluku	473.9	1,890.7	2,851.3	282.8	5,498.7
Irian Jaya	2,076.3	961.8	3,286.0	569.9	6,894.0
TOTAL	**27,327.0**	**41,912.1**	**172,030.0**	**26,101.7**	**267,370.8**

[a] Provinces which contain Project components.

Source: DGH, October 1995.

PROJECT FLIGHT IMPLEMENTATION SCHEDULE: APPRAISAL VERSUS ACTUAL IMPLEMENTATION



Legend:
Appraisal

COMMENTS ON THE SIMPLIFIED FINAL ENGINEERING DESIGN APPROACH

1. An important implementation aspect of the Project was the use of the simplified final engineering design (SFED). Because the Project covered six provinces and a road network of more than 2,900 kilometers, it was necessary to develop a system that would allow preliminary engineering decisions to be made ahead of specific agreements with contractors. The SFED approach was followed, but in some cases, the time savings were lost when difficult terrain was encountered. The Project Completion Report (PCR) was slightly critical of the SFED. Consequently, this appendix seeks to explain the method in further detail. Until 1987, the Directorate General of Highways (DGH) had been very slow in disbursing funds, because of the slow starts in the implementation of projects. The SFED was introduced in 1987 to expedite the disbursement of allocated international funds for road works. The system was developed by experienced international road engineers who recognized that the road sector in Indonesia needed a more rapid engineering design and specifications for contract and funds disbursement system.

2. The introduction of SFED made a substantial improvement in the disbursement of funds after some initial teething problems associated with training staff in its use, particularly at the provincial level.

3. The SFED process was particularly suitable to the conditions in Indonesia and the Government policy of distributing the funds available for road construction (including rehabilitation betterment and all levels of maintenance) over as wide a geographic area as possible.

4. The Government's policy was driven by the political desire for equitable development and it overrode any allocation of funds on a priority ranking based solely on economic internal rate of return (EIRR) or net present value (NPV). All road works funded by the international agencies, however, had to achieve a certain minimum EIRR.

5. The optimization policy, therefore, precluded the major relocation of roads and major earthworks or expensive pavements, because such works would require much larger funds for land acquisition and major construction works. This policy required following the existing alignments and using the existing pavements (where possible) as a base course. The work was primarily one of widening and asphalt concrete overlays because they reduced the roughness of the pavements (a major factor in vehicle operating cost [VOCs]), and improved vehicle capacity, travel times, and safety.

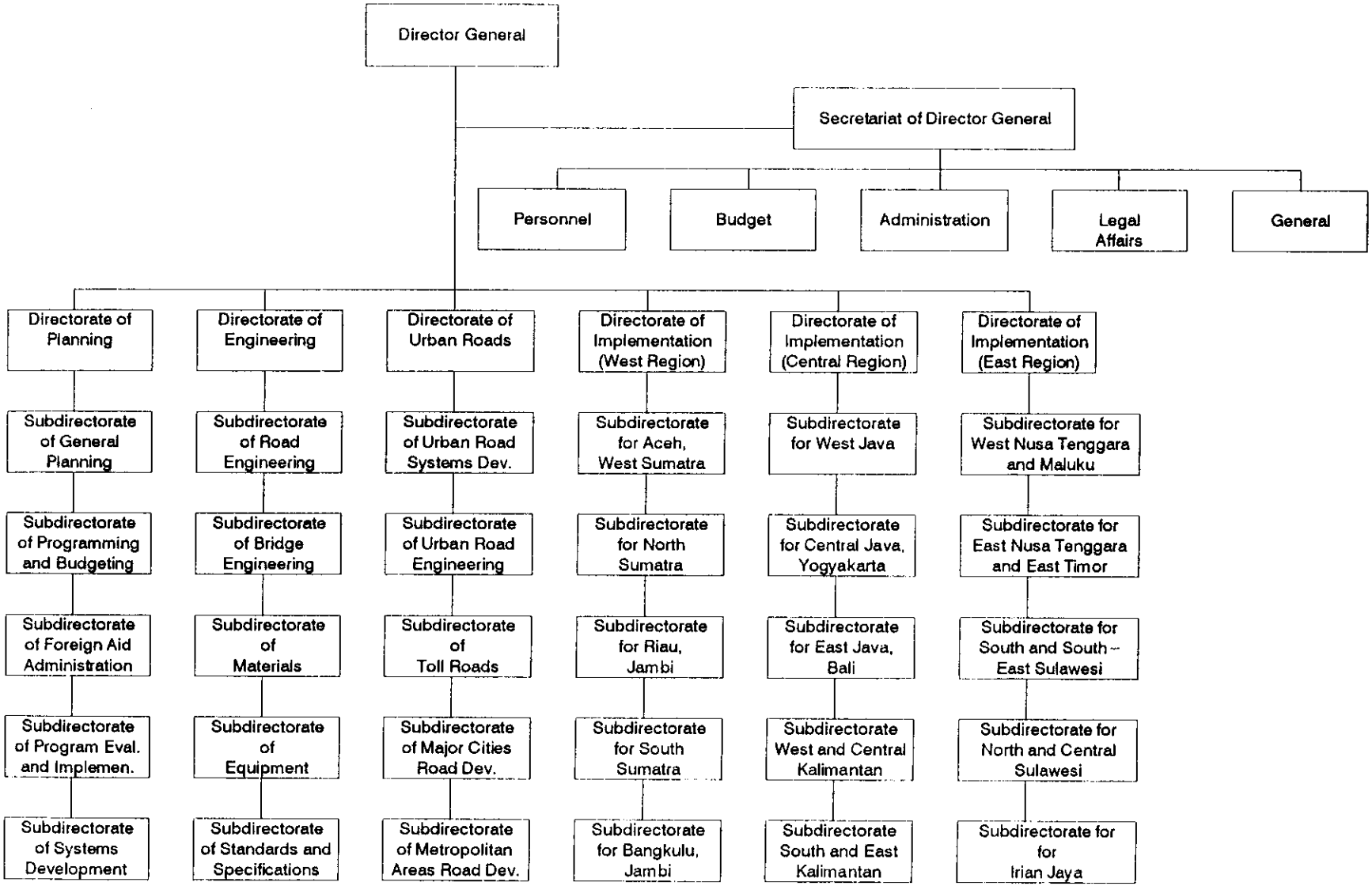
6. The design speed was not a significant parameter in reducing VOC levels and hence, there was no imperative to carry out major improvements to the horizontal or to the vertical alignments. This also precluded the need for significant environmental impacts, such as the removal of trees and urban settlements along the roads.

7. The SFED determined pavement treatments quickly based on estimates of pavement stiffness (Benkelmen beam tests), the incremental roughness coefficient (IRC), average annual daily traffic (AADT), and the EIRR. Hence, it was possible to specify general pavement treatments for sections of roadway very quickly and to allow tenders to be called based on general design concept and a schedule of rates, which facilitated the negotiations of contracts.

8. However, under the Project, the contractors found upon mobilizing, that in some cases the field conditions were quite different from those envisaged in the design documents, which required significant additional geotechnical survey work and increased the bill of quantities. This was the case, particularly in situations where the local geology had not been accurately mapped prior to the Project. Because the quantities were often above the specified range, considerable benefits accrued to the contractor. This would later lead DGH to set ceilings on unit rates.

9. These procedures and systems have been improved over time according to DGH, and if the Project was being done today, the same procedure would be used. The major lessons for future from the implementation of SFED for the Project are the need to (i) ensure that sufficient time is allocated for field surveys to determine the nature of field conditions, and (ii) involve only experienced personnel. The importance of contractors being required to complete all survey activities in a specified period is also being considered by DGH.

ORGANIZATION CHART OF THE DIRECTORATE GENERAL OF HIGHWAYS



Source: DGH, July 1995.

SUMMARY OF APPRAISAL AND ACTUAL PROJECT COSTS
($ million)

Item of Project	Appraised			Actual		
	Local	Foreign	Total	Local	Foreign	Total
Civil Works	37.80	46.20	84.00	48.58	61.27	109.85
Consultant Services	3.50	3.50	7.00	9.83	2.19	12.02
Right of Way	1.00	–	1.00	0.35	–	0.35
Contingencies	21.70	23.30	45.00	–	–	–
Equipment and Tools	0.20	5.50	5.70	0.11	4.61	4.72
Interest and Other Charges	–	16.50	16.50	–	16.50	16.50
Total	**64.20**	**95.00**	**159.20**	**58.87**	**84.57**	**143.44**

SUMMARY OF PROJECT TRAFFIC COUNTS BY MAJOR LINK
ANNUAL AVERAGE DAILY TRAFFIC

No. [a]	Contract Package [a]	Link No.	1991 [b]	1992	1993	1994 [c]	Average Annual Growth Rate(% (1991–1994)
	LAMPUNG						
1	Sukadana – Labuhan	019	2,356	2,903	1,207	1,467	–4.55
2	Sukadana – Jabung	018	1,111	1,268	2,037	2,137	26.56
3	Metro – Tanjungkari	043	1,212	1,457	941	1,339	9.03
4	Terbanggi Besar – Manggala	(013)	3,825	3,345	3,913	4,976	10.53
		(013)	1,902	524	1,051	1,363	19.27
5	Kota Gajan – Seputih Surabaya	041	1,418	1,306	1,537	1,817	9.34
6	Bukit Kemuning – Liwa	(010)	1,048	1,267	1,394	2,203	29.65
		(010)	748	1,341	1,460	2,197	46.21
	WEST JAVA						
1	Nagreg – Garut	050	7,412	8,137	9,821	10,157	11.30
2	Garut – Cikajang	051	3,967	4,408	4,395	5,175	9.52
3	Garut – Tasikmalaya	054	3,928	4,010	4,927	8,047	29.43
4	Tasikmalaya – Cipatujah	059	2,763	2,644	3,401	2,960	3.79
5	Cikijing – Kadipaten	068	3,659	5,113	5,066	4,383	8.45
		069	5,467	4,677	5,854	2,660	–14.62
6	Kuningan – Losari	066	2,561	2,413	3,250	2,916	6.21
7	Cikampek – Pamanukan	008	13,515	17,429	20,701	21,222	16.75
8	Lohbener – Palimanan	010	12,643	12,091	10,255	6,194	–19.72
		025	10,404	11,512	15,313	10,889	4.93
9	Pamanukan – Lohbener	009	12,643	13,810	16,202	14,632	5.62
10	Bandung – Pangalengan	048	9,752	10,532	8,472	11,178	6.79
11	Cilegon – Labuhan	(026)	4,858	5,871	7,242	9,573	25.46
		(026)	1,429	n.a.	7,607	1,582	–79.20 [d]
12	Labuhan – Pandeglang	027	3,343	2,874	4,068	3,905	7.84
		028	3,256	4,238	5,610	3,460	8.07
13	Rangkasbitung – Serang	003	29,580	32,025	30,546	14,475	–16.32
		082	3,525	3,990	4,493	3,301	–0.24
	EAST JAVA						
1	Malang – Pendem – Kandangan	084	10,817	10,693	13,570	16,381	15.49
		(085)	4,613	5,620	5,712	5,452	6.30
		(085)	n.a.	n.a.	5,474	5,198	–5.04 [d]
2	Tuban – Glondong – Blulu	031	n.a.	5,004	4,902	4,725	–2.82
3	Pamasekan – Bluto	146	1,270	2,177	2,647	2,669	31.28

n.a. – not available.

[a] In the sequence as funded by the Loan.

[b] As reported in the PCR.

[c] As estimated by DGH specifically for the PEM; assumes that similar locations and approach were used to that of earlier DGH traffic counts (1991–1993).

[d] Refers to growth rate from 1993 to 1994 only.

Source: DGH Central Office Project Planning Data.

SUMMARY OF PROJECT TRAFFIC COUNTS BY MAJOR LINK
ANNUAL AVERAGE DAILY TRAFFIC
(DGH Counts)

No. [a]	Contract Package [a]	Link No.	1991 [b]	1992	1993	1994 [c]	Average Annual Growth Rate(%) (1991–1994)
	CENTRAL JAVA						
1	Buntu – Kebumen	(050)	5,531	5,531	5,900	6,122	3.48
		(050)	5,531	n.a.	5,891	6,094	3.45 [d]
2	Kebumen – Purworejo	057	5,656	5,656	6,091	6,021	2.18
		060	5,208	5,208	6,214	5,298	1.53
		063	8,454	8,454	8,527	9,013	2.19
3	Semarang – Bawen	010	21,700	21,700	37,146	25,842	13.58
4	Bawen – Salatiga – Boyolali	012	12,927	12,927	9,681	18,617	22.40
		(015)	16,637	16,637	8,882	10,496	−9.48
		(015)	16,637	16,637	8,882	11,911	−4.17
5	Demak – Kudus – Pati	084	11,559	11,559	12,036	13,323	4.94
		086	18,226	18,266	9,941	9,187	−17.65
		088	7,925	7,925	6,562	13,236	28.17
	DISTRICT OF YOGYAKARTA						
1	Yogyakarta – Karangnongko	004	11,928	11,928	10,871	12,044	0.64
		005	12,133	12,133	20,193	5,408	−2.26
		026	1,376	1,376	4,059	1,649	45.20
		006	14,037	14,037	14,137	16,570	5.97
		007	10,273	10,273	13,104	11,252	4.47
	WEST NUSA TENGGARA						
1	Cakranegara – Praya	015	5,543	6,207	6,856	6,995	8.15
		017	1,763	3,779	3,547	4,514	45.16
		020	2,668	1,687	3,022	3,705	21.66
2	Banggo – Dompu – Huu	031	1,819	334	559	501	−8.22
		040	1,684	1,820	400	332	−28.98
3	Dompu – Talabiu – Parado	032	1,672	989	1,445	1,041	−7.57
		033	926	1,973	963	1,212	29.24
		(042)	195	530	764	711	69.67
		(042)	148	399	560	562	70.10
4	Kopang – Lb. Lombok	006	3,379	7,041	5,943	3,879	19.35
		024	6,105	5,851	2,804	4,159	−2.64
		026	1,966	2,674	3,721	3,721	25.06

n.a. – not available.

[a] In the sequence as funded by the Loan.

[b] As reported in the PCR.

[c] As estimated by DGH specifically for the PEM; assumes that similar locations and approach were used to that of earlier DGH traffic counts (1991–1993).

[d] Refers to 1993–94 growth only.

Source: DGH Central Office Project Planning Data.

ANNUAL MOTOR VEHICLE REGISTRATIONS BY PROJECT PROVINCE
(Number of Vehicles)
('000s)

Province/ Police Territory	Year Ended	Type of Vehicles				Total Motor Vehicles
		Passenger Car	Bus	Truck	Motorcycle	
South Sumatra	1991	86.3	86.3	108.7	463.9	691.6
(including Lampung province) [a]	1992	89.6	32.7	117.9	544.6	784.8
	1993	93.1	32.9	127.9	637.2	891.1
West Java	1991	190.4	51.0	125.7	535.2	902.3
	1992	193.7	65.2	131.9	559.9	950.7
	1993	199.7	82.1	138.5	584.7	1,005.0
Central Java [b]	1991	158.8	23.4	144.2	1,172.4	1,498.8
	1992	182.3	24.1	147.4	1,289.6	1,643.4
	1993	209.5	26.0	150.2	1,416.6	1,802.3
East Java	1991	232.4	100.8	169.9	1,416.0	1,919.1
	1992	251.6	103.9	178.6	1,426.4	1,960.5
	1993	271.1	107.5	191.4	1,444.3	2,014.3
West Nusa Tenggara	1991	Data aggregated with Bali and Tim–Tim (Lombok and				
	1992	Sumbawa estimates cannot be disaggregated).				

[a] Approximately 60 percent of vehicles are from Lampung province, the most southern province of Sumatra. All Project roads were limited to the southern province centered on Tanjungkarang (see Map 1).

[b] Includes Yogyakarta.

Source: State Police of Indonesia and PEM estimates.

ECONOMIC REEVALUATION METHODOLOGY

A. Background

1. The reevaluation of the economic performance of the Project was based on the Integrated Road Management System (IRMS) Model[1] of the Directorate General of Highways or Bina Marga (DGH) and subsequently verified by the Postevaluation Mission (PEM) by conducting an independent reestimation of economic internal rates of return (EIRRs) for samples of the road links covered by the Project. The economic reevaluation followed an approach similar to the one developed at appraisal. The IRMS Model was also utilized by DGH in estimating the EIRRs as the basis for selecting the road sections to be upgraded under the Project, and in reevaluating the economic viability of the Project upon its completion.

2. The primary economic benefits of the Project were quantified in terms of savings in vehicle operating costs (VOC) and avoided maintenance costs, by comparing the "without the Project" and "with the Project" situations. The incremental economic costs were arrived at by deducting transfer payments and general price contingencies from the financial costs. The economic costs and benefits have been valued in constant 1994 prices using the manufacturers' unit value (MUV) index and gross domestic product (GDP) deflator for Indonesia. It was assumed that the rehabilitated road links would have an economic life of 20 years, with routine annual and periodic maintenance.

B. Reevaluation of Economic Results by DGH (Use of IRMS Model)

1. IRMS Model

3. Over the past ten years, DGH has developed two computerized screening, evaluation and design systems for road and bridge works known as the IRMS and bridge management system (BMS). The IRMS makes it possible to screen all road sections of the national and provincial network totalling more than 2,000 links, to test and determine optimum treatment levels (from routine maintenance to various levels of betterment works) based on the technical and economic evaluation to produce annual or multiannual work and expenditure programs as a function of available budgetary resources. Within the IRMS there is a planning module, a programming model for maintenance works and for new roads, a budgeting module, a construction implementation/scheduling module and economic analysis module. One of the key components of the IRMS is the Highway Design and Maintenance Standards Model, Version III (HDM-III). The HDM-III, which was initially developed by the World Bank, was first used in Indonesia in 1987. A later revised model constitute the core of the IRMS.

4. The parameters used in the IRMS core program are derived from external data, which are supplied by field engineers and inspectors; and internally-generated data, which are transferred from module to module and subroutine to subroutine. The external data include road network, traffic volume, engineering construction and maintenance costs, financial details

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[1] The model is a variation of the World Bank Highway Design Model (HDM-II). The World Bank and the Transport Road Research Laboratory (TRRL) of the United Kingdom assisted DGH in developing the computer-based screening model.

of contracts, and economic estimates of road user costs, by vehicle type and the economic costs of contracts (without taxes and transfer payment). These economic data are of primary importance in computing the EIRR estimates.

5. The internally generated data include outputs for policies and road standards, detailed costs and design quantities and contractual requirements. At each stage of the model, segments of the road network or the road links that do not match up to the selected engineering standard are put in a queue to be reexamined and to be upgraded to bring the road link into the desirable standard. This leads into the rank-order subroutine (a modified version of the World Bank's HDM-III subroutine), which looks at life-cycle costs of alternative upgrading and then, in turn subjects each alternative to its optimum timing analysis. This is the point where the individual road link is then inserted into the road network and fully appraised. An EIRR for each link is then estimated.

2. Assumptions Used

6. The following assumptions were used in the IRMS model to estimate the EIRRs for the road links covered by the Project.

a. Vehicle Operating Costs

7. The VOC estimates, which are updated by DGH every 18 months, cover six basic vehicle types on a per km basis, within a specified range of design speeds, and for various pavement widths and types of surfaces (see Table 1 on page 32). A key input in the VOC estimates is the estimation of International Roughness Index (IRI), which is a measure of the roughness of the road pavement before and after upgrading, assuming a range of traffic speeds. VOC savings are attributed to reduced surface roughness. IRI values have been collected annually from 1990 to 1994 and the estimates used in the model, as indicated by DGH, were in the range of 2.5 to 4.7. The assumptions relating to the road conditions as described in Table 2 on page 33 are as follows:

"Without the Project"

Road Conditions 10	:	Poor Gravel or Poor-Bad Bitumen Seal
Road Conditions 11	:	Bad Seal/Poor Telford or Road Camber (resulting in poor drainage)

"With the Project"

Road Conditions 4	:	New Penetration Macadam (Bitumen)
Road Conditions 5	:	Good Bitumen Seal

b. Traffic Projections

8. For the years 1995-2000, DGH assumed an average annual rate of traffic growth of 6.5 percent, and for the years 2000 to 2005, an average annual rate of 6.0 percent. These estimates were based on DGH's own assessments of likely vehicle usage and growth in vehicle fleets by province.

c. Maintenance Costs

9. DGH estimates for routine maintenance costs have varied among the provinces, as a result of historic construction methods and vehicle use. For the Project, it was estimated that annual maintenance costs would range from Rp5.3 million to Rp6.2 million per km of upgraded road. Annual maintenance costs in the "without the Project" case, for all links were estimated to range from Rp16.2 million to Rp17.5 million.[1]

3. Limitations of DGH Modelling

10. Although the DGH model is recognized as a suitable instrument for the programming of road works and for selection of subprojects, the Bank, DGH, and other international financing institutions are aware of the shortcomings of the model.[2] For example, based on TRRL and World Bank research, an expected IRI value for a completed road Project should be 2.0. However, all IRI estimates used in the model as indicated by DGH were in the range of 2.5 to 4.7. Because the IRI value has a significant effect on the vehicle operating cost formula, it is important that the IRI data are accurate. A similar finding was recorded in the Project Benefit Monitoring and Evaluation's (PBME) study of the Tenth Road Project, which was completed in September 1995. The report indicated that there were serious questions about the accuracy of the IRI estimates. The implication for the IRMS model is that high IRI estimates are likely to result in higher EIRR estimates after upgrading is fully completed.

11. The quality and reliability of the model's results depend largely on the data inputs. The DGH is aware of data deficiencies relating to (i) traffic counts, (ii) the reliability of VOC estimates by vehicle type, (iii) the impact of varying surface roughness on the levels of VOC, (iv) the importance of traffic generation and diversions after improvements, (v) economic benefits associated with increased trade or agricultural marketing of products, which in the "without the Project" case would not have been transported for sale, and (vi) the importance of accurately estimating the value of time savings.[3]

12. Because of some of the generated questionable results in several road links in the model used by DGH in reestimating EIRRs, the PEM undertook an independent reestimation of the EIRRs for a few road sections under the Project.

4. Independent Economic Reevaluation

13. To verify the results of the DGH's model, a sample of road links were subjected to manual economic reevaluation. Savings in VOC and annual road maintenance were identified as the principal economic benefits that were expected from the rehabilitation and upgrading of the roads under the Project. The VOC savings covered seven different vehicle types. Estimates of forecast traffic data were as reported in Table 3 on page 34. The VOC savings on normal traffic were calculated by multiplying the annual traffic count by the

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1 However, based on an analysis of previous DGH maintenance expenditures, it is unlikely that maintenance costs of more than Rp10 million were incurred.

2 Under the Bank's RETA No. 5549: *Highway Development and Management Research,* approved in October 1993 for $600,000, which supports research to develop further and refine the HDM-III.

3 DGH has recently commissioned a traffic consultant to examine the reliability of IRMS results, based on alternative ranges of input data, in critical ranges.

weighted VOC (to allow for the mix of vehicle types) and the road length which was upgraded. A weighted VOC estimate for each upgraded link was derived from the mix of vehicle traffic for 1994.

14. Economic analysis was carried out on three different road links for which data were obtained independently from DGH and consultants in Indonesia. The following assumptions were used:

(i) VOC Estimates - Table 1 contains the latest VOC data by vehicle type for the roads covered by the Project. Discussions with DGH's consultants indicated that the DGH estimates for road conditions 10 and 11 (in the "without the Project" case), and road conditions 4 and 5 (in the "with the Project" case), were likely to be most representative. For the purposes of the reevaluation, road conditions 4 and 5 have been assumed based on PEM's inspections of most of the road components.

(ii) Savings in Road Maintenance - The "with" and "without" the road link upgrading approach assumed net savings in annual road maintenance of RP10 million per annum. This represents the 'most likely' scenario for the individual links, based on available data and advice from in-country consultants. In the "without the Project" scenario, road maintenance was likely to range from Rp16.2 million to Rp17.5 million per annum. In the "with the Project" case, for road conditions 4 and 5, annual road maintenance is expected to be reduced by Rp5.3 million to Rp6.2 million.

(iii) Traffic Counts -DGH reestimated the traffic counts for all the links covered by the Project in late 1993 for the year 1994. These data have been relied upon together with actual data for the years 1991-1992. Forecast traffic growth of 6 percent for the period 1995-2014 has been assumed. This represents a slightly more conservative scenario than adopted by DGH to the year 2000. It is based on the advice of in-country consultants working for the World Bank and other agencies.

(iv) Other Assumptions

a. The economic life of the rehabilitated roads has been assumed for 20 years, with routine annual maintenance and periodic maintenance expenditures.

b. The economic costs of the individual road links have been updated to 1994 prices using MUV and GDP deflators.

15. Tables 4 to 6 on pages 34-36 show the economic costs and benefits of the three independent road links for which annual construction costs were available and where the annual traffic counts had been considered to have been reliably taken. The following data summarize the EIRRs derived from the reestimates of the PEM.

Road Link	Using Bank Methodology for Road Reevaluation EIRR (%)	Based on DGH IRMS Model EIRR (%)
Tuban-Glondong-Blulu (Eastern Java)	51.5	56
Nagreg-Garut (West Java)	58.2	67
Metro-Tanjunkari (Lampung)	20.3	98

16. Based on a comparison of the results, for each of the three sampled links from the Project, it would appear that the IRMS model has yielded consistently higher results than the PEM's independent economic reevaluation. Given that the PEM's reestimation of EIRRs has been limited to utilizing only VOC and road maintenance benefits, the lower EIRRs estimates obtained would appear plausible.

17. A sensitivity analysis has been undertaken for the three links specifically to examine the likely impact of a reduction in VOC savings resulting from deterioration in road pavements if the problem in truck overloading is not resolved satisfactorily. Sensitivity tests have also been undertaken to assess the potential combined effect of a reduction in VOC savings and no savings in annual maintenance costs. The EIRR results for the three sample road links were as follows:

Road Link	(A) Impact of 20% Reduction in VOC Savings (EIRR as %)	(B) Combined Impact of (A) and No Maintenance Savings (EIRR as %)
Tuban-Glondong-Blulu (Eastern Java)	44.4	40.1
Nagreg-Garut (West Java)	47.3	42.6
Metro-Tanjunkari (Lampung)	16.0	9.3

18. The sensitivity tests conducted for the three sample links indicate that despite the uncertainties associated with the EIRR estimation by DGH for the individual road links for the Project and the lower estimates for the sample of road links for which EIRRs were recomputed, the results obtained confirm that the Project has been generally successful. In

the case of Metro-Tanjukari (Lampung) link, the combined reduction in VOC savings and lack of maintenance savings would most likely have an unfavorable effect on the road section's economic viability.

19. In the future, it is considered necessary that the Bank undertake an independent EIRR estimation of all road links rather than rely solely on DGH to generate EIRR estimates for the Bank's loans.

Table 1: Economic Vehicle Operating Costs (1994 Rp per km)

Vehicle Type	Without Project Road Condition (10–11)	With Project Road Condition (4–5)	VOC Savings (Rp/km)
Car/Jeep	432 – 496	352 – 404	90 – 92
Pick–up (passenger)	282 – 322	221 – 255	61 – 67
Pick–up (freight)	286 – 329	227 – 262	59 – 67
Bus	542 – 623	473 – 544	69 – 79
Light Truck < 5 tons axle	395 – 455	319 – 366	76 – 89
Medium Truck 5 – 10 tons axle	712 – 819	557 – 640	155 – 179
Heavy Truck > 10 tons	953 – 1096	824 – 948	129 – 148

Source: DGH, Jakarta and ADB Tenth Road (Sector) Project field data prepared by Louis Berger International, Inc., December 1994.

Table 2: Road Conditions, Roughness, and Average Speed
DGH Standards

Road Condition	Condition Code	Roughness mm/km	Average Motorized Vehicle Speed (km/hr)
New Hot Rolled Sheet	3	3,000	60
New Penetration Macadam	4 [a]	4,000	55
Good Seal	5 [a]	5,000	50
Good Gravel	6	6,000	45
Fair Seal	7	7,000	35
Fair Gravel/Fair–Poor Seal	8	8,000	35
Poor Seal/Fair–Poor Gravel	9	9,000	30
Poor Gravel/Poor–Bad Seal	10 [b]	10,000	25
Bad Seal/Poor Telford	11 [b]	11,000	20
Poor Earth/Poor–Bad Gravel	12	12,000	15
Bad Gravel/Bad Telford	13	13,000	12.5
Bad Earth	14	14,000	10

[a] "With the Project" road conditions in each of the six provinces.
[b] Road conditions that best describe the sections prior to the Project.

Table 3: Traffic Volumes and Weighted VOC Estimates Of Sampled Road Links

Road Link	Road Length (km)	Annual Average Daily Traffic Count (AADT) 1991	1994	1995	1996	2004	Weighted VOC Savings (1994) Rp/km
Tuban–Glondong–Blulu	47.7	n.a.	4,725	5,009	6,323	8,462	89.9
Nagreg–Garut	48.7	7,412	10,157	10,766	13,592	18,189	81.5
Metro–Tanjunkari	27.0	1,212	1,339	1,419	1,792	2,398	98.2

Source: DGH and PEM.

Table 4: Economic Reevaluation of Tuban–Glondong–Blulu Link (Rp million, 1994 prices)

Year	Costs		Benefits		Net Benefit Stream
	Capital [a]	Maintenance [b]	VOC Savings [c]	Avoided Maintenance Costs [d]	
1988	1,397.6				(1,397.6)
1989	3,445.5				(3,445.5)
1990	656.4				(656.4)
1991		252.8	4,052.0	510.4	4,309.6
1992		252.8	4,295.1	510.4	4,552.7
1993		252.8	4,552.8	510.4	4,810.4
1994		252.8	4,826.0	510.4	5,083.6
1995		252.8	5,115.6	510.4	5,373.2
1996		252.8	5,422.5	510.4	5,680.1
1997	4,399.2 [e]	252.8	5,747.8	510.4	1,606.2
1998		252.8	6,092.7	510.4	6,350.3
1999		252.8	6,458.3	510.4	6,715.9
2000		252.8	6,845.8	510.4	7,103.4
2001		252.8	7,256.5	510.4	7,514.1
2002		252.8	7,691.9	510.4	7,949.5
2003		252.8	8,153.4	510.4	8,411.0
2004	4,399.2 [e]	252.8	8,642.6	510.4	4,501.0
				EIRR	**51.5%**

[a] As derived for 1994, using MUV and GDP deflators for 1988–2004 (in financial prices) and using a SCF of 0.8

[b] Assumes an annual maintenance cost of Rp5.3 million per km, allowing for periodic maintenance.

[c] Assumes 200 days per year at the AADT estimate provided by DGH and weighted VOC savings for all vehicle types over the entire length of link.

[d] Based on DGH's estimates of savings in annual maintenance costs with improvements in pavement condition

[e] Assumes resealing after six years due to oxidization of the bitumen (also assumes that the subbase will requir some recompaction after replacement).

Table 5: Economic Reevalaution of Nagreg–Garut Link
(Rp million, 1994 prices)

Year	Costs		Benefits		Net Benefit Stream
	Capital [a]	Maintenance [b]	VOC Savings [c]	Avoided Maintenance Costs [d]	
1988	1,554.7				(1,554.7)
1989	2,178.6				(2,178.6)
1990	1,638.9				(1,638.9)
1991		258.1	6,450.4	521.1	6,713.4
1992		258.1	6,837.4	521.1	7,100.4
1993		258.1	7,247.7	521.1	7,510.7
1994		258.1	7,682.5	521.1	7,945.5
1995		258.1	8,143.5	521.1	8,406.5
1996		258.1	8,632.1	521.1	8,895.1
1997	4,297.7 [e]	258.1	9,150.0	521.1	5,115.3
1998		258.1	9,699.0	521.1	9,962.0
1999		258.1	10,281.0	521.1	10,544.0
2000		258.1	10,897.8	521.1	11,160.8
2001		258.1	11,551.7	521.1	11,814.7
2002		258.1	12,244.8	521.1	12,507.8
2003		258.1	12,979.5	521.1	13,242.5
2004	4,297.7 [e]	258.1	13,758.2	521.1	9,723.5
				EIRR	**58.2%**

[a] As for Table 4.

[b] As for Table 4.

[c] Assumes 160 days per year at the AADT estimate provided by DGH and weighted VOC savings for all vehicle types over the entire length of link.

[d] As for Table 4.

[e] As for Table 4.

Table 6: Economic Reevaluation of Metro–Tanjunkari Link (Rp million, 1994 prices)

Year	Costs		Benefits		Net Benefit Stream
	Capital [a]	Maintenance [b]	VOC Savings [c]	Avoided Maintenance Costs [d]	
1987	523.2				(523.2)
1988	1,000.2				(1,000.2)
1989	1,574.4				(1,574.4)
1990	644.7				(644.7)
1991		143.1	887.5	288.9	1,033.3
1992		143.1	940.8	288.9	1,086.6
1993		143.1	997.2	288.9	1,143.0
1994		143.1	1,057.0	288.9	1,202.8
1995		143.1	1,120.4	288.9	1,266.2
1996		143.1	1,187.7	288.9	1,333.5
1997	2,619.6 [e]	143.1	1,258.9	288.9	(1,214.9)
1998		143.1	1,334.5	288.9	1,480.3
1999		143.1	1,414.5	288.9	1,560.3
2000		143.1	1,499.4	288.9	1,645.2
2001		143.1	1,589.4	288.9	1,735.2
2002		143.1	1,684.7	288.9	1,830.5
2003		143.1	1,785.8	288.9	1,931.6
2004	2,619.6 [e]	143.1	1,893.0	288.9	(580.8)
				EIRR	**20.3%**

[a] As for Table 4.

[b] As for Table 4.

[c] Assumes 250 days per year at the AADT estimate provided by DGH and weighted VOC savings for all vehicle types over the entire length of link due to the lower traffic volumes.

[d] As per Table 4.

[e] Assumes a lower resheeting and rolling cost after seven years as compared to the Tuban–Glondong–Blulu and the Nagreg–Garut links.

Table 7: Economic Costs of Selected Road Links for Reevaluation (in Rp million)

Road Links	Year	Total Capital Costs	Economic Costs				
			Foreign		Local [a]		Total
		Current	Current	Constant (1994)	Current	Constant (1994)	Constant (1994)
Glondong–Blulu	1988	1,020	612	873.41	326	524.17	1,397.58
	1989	2,670	1,602	2,192.45	854	1,253.05	3,445.50
	1990	560	336	417.36	179	239.00	656.36
	Total	4,250	2,550	3,483	1,359	2,016	5,499.44
Nagreg–Garut	1987	1,040	624	979.74	333	574.91	1,554.65
	1988	1,590	954	1,361.49	509	817.09	2,178.58
	1989	1,270	762	1,042.85	406	596.02	1,638.87
	Total	3,900	2,340	3,384.08	1,248	1,988.01	5,372.09
Metro–Tanjunkari	1987	350	210	329.72	112	193.48	523.20
	1988	730	438	625.09	234	375.14	1,000.23
	1989	1,220	732	1,001.79	390	572.55	1,574.35
	1990	550	330	409.91	176	234.74	644.65
	Total	2,850	1,710	2,366.51	912	1,375.91	3,742.42

[a] SCF of 0.8 was applied to correct for market distortions.

Source: DGH and ADB Seventh Road (Sector) Project Completion Report.

Table 8: Economic Reevaluation Results

Province	Contract Package	Link No.	DGH–Generated EIRR Estimates (%) Appraisal (1984) [a]	PCR (1991)	PEM (1995)	Independent Reevaluation of EIRR estimates PEM (1995)
Lampung	Sukadana – Simpang – Maringgai [b]	019	26	59	72	
	Metro – Tanjungkari	043	68	93	98	20
West Java	Nagreg – Garut	050	58	59	67	58
	Garut – Tasikmalaya	054	41	48	74	
	Kuningan – Losari	066	77 [e]	45	49	
	Cikampek – Pamanukan [c]	008	–	85	91	
Central Java	Semarang – Bawen	010	82 [e]	–	44	
East Java	Tuban – Glondong – Blulu	031	17	52	56	52
West Nusatenggara	Cakranegara – Dosan Carmen [d]	015	140	–	62	
	Banggo – Dompu	030	76	52	59	

[a] Based on 1981 AADT data (as per appraisal).

[b] Corresponds to G. Dalam–Labuhan–Maringgai in the AR.

[c] Originally Link No. 009, Pamanukan–Lohbener at Appraisal and part of 008, Jatisari–Pamanukan at Appraisal.

[d] Spelt Cakranegara–Dosancermin at Appraisal.

[e] DGH considers the underlying traffic volumes to have been overestimated in 1981.

SUMMARY OF ROAD MAINTENANCE EXPENDITURES
1984/85 to 1993/94
(Rp billion)

Year Ended June	Actual Maintenance Expenditure on National and Provincial Roads	Total Road Expenditure	Actual Maintenance as percent of Total Road Expenditure	Road Expenditure as percent of Government Expenditure
1985	141.1	9952.0	1.41	9.0
1986	154.1	10,873.0	1.41	8.2
1987	164.8	8,332.0	1.97	12.3
1988	258.2	9,472.0	2.73	16.2
1989	187.2	12,251.0	1.52	12.7
1990	313.1	13,834.0	2.26	15.4
1991	448.7	19,452.0	2.31	13.5
1992	563.5	19,998.0	2.82	20.0
1993	614.8	22,912.0	2.68	21.0
1994	767.6	23,476.0	3.26	21.6

Source: DGH and National Development Planning Agency (BAPPENAS).

OVERLOADING OF VEHICLES

1. The Directorate General of Highways (DGH), in 1992, commenced a study to examine the extent of overloading vehicles throughout Indonesia. Based on a comprehensive survey of 154 road links, in 22 provinces involving 2.7 million vehicle movements, a detailed review was made of vehicle damage to road pavements. Some of the road links that were included were links that had been upgraded under the Project. Individual survey teams undertook axle load measurements on provincial and urban roads over a 16-month period. The study was completed in December 1993.

2. DGH's design system is based on two national standards. These correspond to roads being capable of carrying vehicles equivalent to having a eight or ten ton load on a single dual tire axle. All single dual tire axle weights should thus not exceed ten tons if pavement damage is to be avoided.

3. The database which was collected and developed covered the following variables:

- type of vehicle (12 classes from motorized passenger cycles to heavy trucks)
- speed of vehicle
- overall length of vehicle
- total weight of the vehicle (in kgs)
- the weight of each axle (in kgs)
- the spacing between each axle in meters.

4. One of the basic requirements of the field surveys of axle loads was to provide adequate data to estimate the average equivalent standard axle (ESA) weight for use in DGH's pavement design. The ESA data is critical to the design phase, as it is based on the average mean vehicle axle loads for axle groups, and on the average daily traffic (ADT) volumes for a specific road link. The total daily ESA value for the heaviest direction of travel is thus used for final pavement design specification. Thus, it was important to establish reliably what the range of ESA values were for Indonesian-wide roads, including a sample of road links covered by the Project.

5. Key results of the study for the six provinces covered by the Project are summarized in the accompanying table. Data is presented for the average annual daily traffic (AADT) estimates, daily counts, vehicle type splits, average and total ESAs and the extent to which movements exceed 8 and 10 ton single axle limits. West Java was reported to have the highest percentage of vehicles exceeding the 10 tons per axle upper limit (38 percent). For the total of trucks and buses for all of Indonesia, 42 percent of all single axle counts exceeded the upper weight limit of 10 tons per single axle. This is to be regarded as a major problem for the protection of the Indonesian road pavements.

6. In summary, the results of the survey indicated that 6.5 percent of all axles that weighed more than 10 tons caused 90 percent of the damage to road pavements. Throughout all of the Project roads, vehicle overloading was a significant problem, with an average of 22 percent of all vehicles exceeding the 10-ton single axle weight limit.

SUMMARY REPORT FOR ALL PROVINCES OF INDONESIA SURVEYED BY CWU PROJECT

	No. of Links	1992 AADT Volume	Count/ day	Composition (%)			All Vehicles Vehicle Damage		All Vehicles Gross Weight (%)		
				Car	Truck/ Bus	Articulated Truck (more than 4 axles)	Average ESAs	Total ESAs	< 8 tons	–	> 8 tons
Aceh	8	16,836	12,555	60	40	0	0.866	10,873.8	78	2	20
North Sumatera	8	65,638	60,507	51	49	0	0.937	56,710.0	80	3	17
West Sumatera	8	23,242	26,590	56	44	0	0.905	24,068.3	76	2	22
Riau	8	17,557	14,686	43	56	1	1.749	25,688.4	67	4	30
Jambi	7	12,428	9,598	50	50	0	1.332	12,781.0	64	5	31
Bengkulu	7	33,737	10,136	71	29	0	0.481	4,870.7	82	1	18
South Sumatera	8	50,372	29,114	54	46	0	1.199	34,906.5	72	3	25
Lampung	8	56,281	47,029	51	49	0	1.239	58,285.8	74	3	23
West Java	13	252,299	156,854	45	54	1	2.739	236,805.3	54	8	38
Central Java	13	151,552	129,561	57	42	1	0.798	103,404.5	76	5	18
Yogyakarta	4	73,851	20,249	43	57	0	0.711	14,396.6	82	2	16
East Java	14	149,865	143,253	48	51	1	1.253	179,931.4	79	4	17
West Kalimantan	6	16,713	14,044	52	48	0	0.097	1,356.5	84	0	16
East Kalimantan	4	6,719	10,705	65	35	0	0.130	1,394.2	90	0	9
South Kalimantan	6	20,272	23,708	72	28	0	0.176	4,181.8	86	0	14
Bali	4	41,614	37,743	71	28	0	0.632	23,866.5	80	1	19
West Nusatenggara	2	6,386	6,649	78	21	1	0.657	4,365.9	79	0	21
East Nusatenggara	4	8,215	12,166	56	44	0	0.120	1,463.4	90	0	9
North Sulawesi	6	13,162	22,276	57	43	0	0.578	12,886.2	92	0	8
Central Sulawesi	6	6,194	5,692	65	35	0	0.199	1,134.4	81	0	19
South Sulawesi	6	33,783	26,293	59	41	0	0.824	21,668.3	80	1	18
South East Sulawesi	4	17,648	7,372	66	34	0	0.278	2,046.4	88	1	11
Summary of All Vehicles	**154**	**1,074,364**	**826,780**	**53**	**47**	**0**	**1.013**	**837,258.1**	**79**	**3**	**18**

Source: DGH Central Weighbridge Unit (CWU) Project, December 1993.