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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT  
INTERNATIONAL DEVELOPMENT ASSOCIATION

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APPRAISAL OF  
A HIGHWAY PROJECT  
INDONESIA

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Transportation Projects Department



INDONESIA

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This report has been prepared by Messrs. P.O. Malone (Engineer) and W. Thalwitz (Economist).

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## INDONESIA

### APPRAISAL OF A HIGHWAY PROJECT

#### SUMMARY

- i. Indonesia's transport system is basically well-planned and if in sound condition would be adequate for the country's present needs. However, as a result of years of neglected maintenance, all transport facilities are run down; conditions are aggravated by a general lack of managerial expertise. A major effort is underway by international and bilateral agencies to meet the most pressing needs, both technical and administrative, within the transport sector.
- ii. On Indonesia's roads, riding quality is consistently poor and the neglect of maintenance, particularly that of the drainage systems, is causing wide-spread pavement failure. As a result, road transport costs are high and tend to inhibit agricultural production. Indeed some important food-producing areas are already cut off from their markets. Rehabilitation of the highway network is particularly urgent, therefore, if the country's plans to increase food production are to materialize and if large investments to replace failed roads are to be avoided in the near future.
- iii. The UNDP is financing a study, "1968-70 Highway Services", for which the Bank is executing agency, to determine investment priorities for highways and to assist in planning effective highway administration. The consultants for the study, KAMPSAX (Denmark)/Louis Berger (USA), during the first phase of their work, December 1968 - April 1969, inventoried most of the important roads in the country and as a result proposed, in their interim report of April 1969, a rehabilitation program covering about 12,000 km of road, and defined the most urgent investments required therefor.
- iv. The proposed project, part of a larger rehabilitation program, is based on the interim report, and would concentrate on the most urgent rehabilitation needs. Financial and managerial constraints require, in fact, that the rehabilitation work under the project be no more than about one-quarter of the program recommended by the consultants. The project would, however, also provide the technical and organizational support needed for this and for all future highway work.
- v. In detail the project would consist of the following:
- rehabilitation of about 3,000 km of roads in five provinces;
  - improvement of routine and periodic road maintenance in those five and a further 15 provinces;
  - rehabilitation of workshops in 20 provinces;
  - implementation of inventory and costing techniques;

- implementation of pilot training and experimental programs for all phases of highway work; and
- technical assistance to support the above operations.

The project would have a major impact in 20 of the country's 26 provinces; the remaining six provinces do not have significant highway problems at this time.

vi. Capital expenditure over the four-year project period would amount to US\$46.7 million equivalent. The Association would finance imported equipment and materials, and the technical assistance required for the project, totalling US\$28 million. The local currency component of capital expenditures (US\$18.7 million equivalent) would be financed by the Government. The Government would also finance all recurrent expenditures for the project, totalling US\$9.5 million equivalent. The proposed rehabilitation work is widely scattered and could not easily be quantified for contracting purposes; the rehabilitation program would therefore be executed departmentally. The Directorate-General of Highway Construction, one of the branches of the Ministry of Public Works and Power, would execute the project on behalf of the Government.

vii. Because rehabilitation under the project would necessarily be limited to roads of highest economic priority, the rates of return on the investment are very large; the weighted average rate of return on the investments for rehabilitation of the specific road sections included in the project is over 40%. The economic evaluation is based on a comparison of rehabilitation costs and the resulting reductions in vehicle operating costs, excluding possible savings in maintenance expenditures and future capital costs.

viii. The project provides a suitable basis for a credit of US\$28 million equivalent to the Government of Indonesia.

## INDONESIA

### APPRAISAL OF A HIGHWAY PROJECT

#### 1. INTRODUCTION

1.01 The Government of Indonesia has asked the Association for a credit to help finance a project comprising:

- (i) rehabilitation of about 3,000 km of high-priority roads;
- (ii) improvement of road maintenance operations;
- (iii) rehabilitation of workshop facilities;
- (iv) establishment of pilot training and experimental programs for all phases of highway work;
- (v) implementation of inventory and costing procedures;
- (vi) provision of technical experts to support the above operations.

1.02 The project arises from a current UNDP Study ("1968-70 Highway Services"), for which the Bank is executing agency, the objects of which are to determine investment priorities for highways and to assist in planning efficient highway administration. The study, which began in late 1968, is being carried out by the consultants KAMPSAX (Denmark)/Louis Berger (USA). As a result of the first phase of their investigation the consultants have proposed a rehabilitation program covering about 12,000 km of roads.

1.03 The project includes about one-quarter of the consultants' program. It would meet the most urgent highway rehabilitation needs and would in addition provide the necessary technical and administrative organization for this and future road rehabilitation and development. It would be the first loan/credit for transportation in Indonesia.

1.04 The project is based on the consultants' findings as of April 1969. This report has been prepared by Messrs. P. Malone (Engineer) and W. Thalwitz (Economist) who appraised the project in March/April 1969.

## 2. BACKGROUND

### A. General

2.01 Indonesia is an archipelago of more than 3,000 islands stretching 5,000 km along the equator, or a distance equivalent to that across the continental United States. The total land area, about 1.9 million km<sup>2</sup> (including West Irian) is about four times that of France. The major islands, Java, Sumatra, Sulawesi and Kalimantan, account for about 70% of the total land area. (See Table 1)

2.02 The population is estimated at about 115 million, growing at about 2.4% p.a. About 75 million people (or 65% of the total population) live in Java which, however, accounts for only about 7% of the land area. Population pressure in Java and Bali is intense, while vast parts of other islands, particularly Kalimantan, are undeveloped and underpopulated. The Government, therefore, is attempting to resettle people from Java and Bali to other islands. Urbanization is accelerating and the capital, Djakarta, has a population of over four million. Five other cities, Surabaya, Bandung, Semarang and Jogjakarta in Java, and Medan in Sumatra, have passed the half million mark.

2.03 The main islands are mountainous and are characterized by intense seismic and volcanic activity. Broad coastal plains extend across northern Java, eastern Sumatra and southern Kalimantan. Rainfall is ample everywhere but regional variations range from about 1.5 m to 5.0 m per annum. Heaviest rainfall occurs during the west monsoon season, November through April.

2.04 Indonesia has great potential resources. Nevertheless, with a GDP of about US\$80 per capita, it is one of the poorest countries in the world. Over the past 10 years income growth has barely kept pace with population growth. About 75% of population are occupied in agriculture which accounts for about 50% of the GDP (Rp. 226 billion in 1967). A large portion of agricultural output consists of crops for exports produced in plantations and by smallholders (Rp. 100 billion worth of rubber, coffee, oil palm products, copra, tobacco, tea and pepper, in 1967).

2.05 At present the economy is recovering from a period of stagnating production and rapid inflation. The inflation rate during 1968 decreased to just over 1% per month. Among the factors helping to bring this about were a good rice crop and large imports of PL 480 food grains. The value of exports in 1968 grew by about 8% with petroleum, which accounted for about Rp. 80 billion equivalent in 1967, growing most rapidly. The return of stability has encouraged domestic and foreign investors, and the Government plans to increase development expenditures from Rp. 36 billion in 1968 to Rp. 123 billion in 1969. The economic recovery and the expected increase of output will make additional demands on Indonesia's run-down transportation system. A number of Governments, the UNDP and the Bank Group are assisting Indonesia to meet these growing demands either by technical assistance or direct financial help, as indicated in the following paragraphs.

## B. The Transportation System

### a. General

2.06 Indonesia has a basically sound transport system which, if efficiently operated and maintained, could adequately serve present transport requirements. However, facilities in all modes of transport have fallen into disrepair as a result of long neglect and lack of maintenance. The lack of managerial capacity has compounded the effects of scarcity of funds for the maintenance of existing facilities. As a result, the limited maintenance funds available have been mismanaged, investments have been planned haphazardly, and facilities have been operated inefficiently. Government is therefore rightly laying emphasis in the transport sector on planning and management. The UNDP Highway Services (para. 1.02) are developing a framework for planning and execution of rehabilitation and development for highways, and bilateral agreements are likewise providing effective assistance in other transport modes, (the Netherlands in aviation and inter-island shipping, and the Federal Republic of Germany in railways).

2.07 As an archipelago, Indonesia uses sea communication as the trunk transport system. There are few natural harbors, but there are an adequate number of ports which connect with the main road and rail arteries of the islands. The inter-dependence of the islands supports sea-borne trade, mainly in rice, copra, oil products, cattle, construction materials, and local and imported manufactured consumer goods. While the road and rail systems primarily connect the interior of the islands with the ports, they also serve to connect surplus and deficit areas within the islands.

### b. Highway Transport

2.08 The highway network consists of about 82,000 km of roads of all standards and classifications (Table 1). Paved roads total about 15,000 km and are mostly found on the 32,000 km network of national and provincial roads (Table 3). The riding quality of most of the system, whether paved or not, is extremely poor; large sections are permanently impassable, others must be closed during the rainy season. (Further details are given in paragraphs 3.01 - 3.05).

2.09 Because of the low standards adopted for road and bridge design, vehicles tend to be small. More than half of the vehicles are over-age. These factors, coupled with the deteriorated condition of the roads, lead to high road transport costs.

### c. Railways

2.10 The state railroad organization (PNKA) operates about 7,900 km of track, of which 5,000 km form an interconnected system on Java. Sumatra has four non-connecting lines totalling 2,200 km. The gauge of the system is generally 1.075 m, but the 540 km Atjeh line in Sumatra has a gauge of 0.75 m,

and there are about 100 km of 0.60 m track on Java. Infrastructure and rolling stock are in bad condition. Track and bridge maintenance has been neglected since 1939; two-thirds of the entire rolling stock is over 40 years old and 75% of the locomotives are steam-powered. Service to shippers is slow and not always reliable. The average turnaround time for freight wagons approaches one month for a haul of 300 km. PNKA is heavily over-staffed. If the social problems involved could be resolved, it could halve its staff of about 85,000 and achieve acceptable ratios of traffic output units per employee.

2.11 PNKA is predominantly a passenger railway, with goods traffic during the last six years accounting for only about 15% of total traffic. The railway's share in total land transport of goods is small, probably below one-tenth. Between 1962 and 1967 both goods and passenger transport by rail declined, from about 1.0 billion ton-km and 7.0 billion pass-km in 1962 to about 0.6 billion ton-km and 4.5 billion pass-km in 1967. However, provisional data for 1968 show an increase of 35% in freight ton-km. The operating deficit, which must be borne by the Government, is expected to amount to Rp. 5 billion (US\$16 million equivalent) in 1968.

#### d. Ports and Shipping

2.12 There are several hundred ports in the archipelago but the bulk of traffic is handled by about 70. The most important of these are Tandjung Priok (Djakarta) and Surabaya in Java, Belawan and Palembang in Sumatra, Pontianak and Bandjermasin in Kalimantan, Makassar and Bitung in Sulawesi, Ambon in the Moluccas and Sukarnapura in West Irian. Berthage capacities are generally adequate. However, port operations in Indonesia are hampered by conflicting and overlapping administrative responsibilities and lack of supporting facilities. Government investment plans provide for power and water supply, navigational aids and telecommunications, tugs and barges. Technical and economic studies will be undertaken during 1969/70 to determine the extent of the dredging backlog, and to work out schedules for rehabilitation and utilization of the Indonesian dredging fleet.

2.13 The inter-island shipping fleet of powered vessels over 500 tons has a capacity of about 300,000 dwt; almost half the fleet is operated by the state owned organization PELNI. The productivity of the fleet is low, having declined from more than 10 tons carried annually per available ton of dead-weight capacity to about five tons at present. There is no capacity shortage but the fleet is in bad physical condition. Acting on the recommendations of a Dutch advisory team, PELNI will reduce its fleet capacity by about 25% and rehabilitate the rest. The 130 private shipping companies and PELNI will pool their revenues and maintain regular schedules; this will enable shippers to plan their cargo movements rationally and will permit a better utilization of the whole fleet. Indonesia has a large fleet of sailing boats the capacity of which (400,000 dwt) exceeds that of the powered fleet. During the last few years this fleet has made substantial inroads into the shipping market and now handles about half of the inter-insular shipping volume. Even large companies use sailing vessels

for the transport of costly and fragile equipment since owner-operated sailboats are a guarantee of reliable and speedy delivery, free from pilferage.

2.14 River transport has only local significance. It is of particular importance, however, in eastern Sumatra where the road system is not developed to provide adequate connections between the interior and the ports.

e. Aviation

2.15 Due to the long distances between islands and the inaccessibility of the interior of some larger islands, air transport is growing. In addition, international air communications are being improved to cater for the tourist traffic, especially to Bali. The two international airports, in Djakarta and in Bali, can accommodate the long-haul jet aircraft. There are 36 other airports of which five will be able to receive medium-range jets. All other airports will be improved during the present Five-Year Plan (1969 - 1973), to accommodate Fokker F-27 turbo-prop aircraft.

2.16 The fleet for the domestic operations of the national airline, Garuda, is largely obsolete and will be replaced during the next five years. Commitments have been made for the acquisition of two DC9s and 10 Fokker F-27s. Traffic to Europe and Japan is handled by two DC-8s, in cooperation with KLM, and two Convair 990 turbojets fly within south-east Asia. During the last year Garuda's operations have markedly improved in quality of service and profitability. Garuda is probably the only state enterprise that has solved the problem of overstaffing and has a chance to earn depreciation charges on its equipment in the future. However, there is room for better capacity utilization of the existing and future fleet. This would be possible even without additional investments if existing facilities on Indonesian airports were operated for longer hours.

f. Transport Policy and Coordination

2.17 The main components of Indonesia's transportation system, sea communication and land transport, are complementary. Coordination of competing modes of transport is only required for land transport on Java and Sumatra where the railways have a much smaller network than highways and a small share of total traffic volume. However, since the infrastructure and rolling equipment of both modes of transport are seriously run down, competing claims on resources for investments are substantial, and the need to apply economic criteria to determine priorities and to ration funds is, therefore, particularly pressing. Railway investment requirements alone have been estimated by PNKA to amount to about US\$140 million equivalent for the rehabilitation of major lines during the next five years. Until now, investment decisions in the transport sector have not been based on economic studies, but the Government recognizes that additional economic analyses will be required to determine whether adequate benefits to the economy would justify the large rail investments proposed by PNKA in the Five-Year Plan. In the meantime, the railways proceed cautiously with the most urgent

investments for track rehabilitation and rolling stock renewal on the two most important lines in Java and Sumatra. Although road investments are now being prepared under the Highway Services, on the basis of a comparative analysis of costs and benefits, a systematic assessment of priorities between road and rail investments will not be possible until proposed major rail investments have been subjected to thorough analysis, with the assistance of the German Management and Planning team, which is scheduled to arrive in July 1969.

2.18 Shippers, when choosing between road and rail, are frequently influenced more by consideration of quality of service than by comparison of rates and tariffs. The influence of Government taxation policies on the allocation between modes is therefore small. The pump price of regular grade motor fuel in Djakarta was recently raised from Rp. 16 per liter to Rp. 17 per liter (or to about US\$19.7 per US gallon). This is at least US\$10 less than the average pump price in the US.

2.19 There is no specific fuel tax in Indonesia but the total profits of oil companies are turned over to the Government. For 1968 the profit on domestic sales, divided by the quantities of fuel sold, was about Rp. 9 per liter or about US\$10.4 per gallon. Profits remitted to the Government are not a good measure of the contribution by road users, since oil company profits are inflated as a result of low crude prices which do not reflect the international price or the opportunity cost of fuel to the economy. There is also a substantial subsidy on kerosene which is deducted from these profits. On balance it would appear that gasoline is taxed at about US\$2-3 per gallon, which is a modest contribution by users to the road budget. However, vehicle imports are subject to heavy duties ranging between 40 and 300 p.c. of landed cost, which is an impediment to the development of road transport.

2.20 Transport policies at present include no restrictive administrative regulation upon the growth of road transport. The allocation of traffic, routing and distances is left to competition; within the road transport industry tariffs adjust to market conditions, although in theory the provinces establish controlled rates.

2.21 The institutional arrangements for transport coordination are at present unsatisfactory. Efforts are being made by BAPPENAS, the National Planning Council, to coordinate investments based on proposals for roads prepared by the Ministry of Public Works and Power, and for all other transport investments by the Ministry of Communications. This latter Ministry also has the responsibility for the regulation of transport industries. However, neither of the Ministries nor BAPPENAS has the staff to subject major investments to thorough comparative analyses of cost and benefits. A comprehensive economic survey on traffic cost and allocation, transport investments and rate policies is presently being undertaken by the Transport Coordination Advisory Team under the UNDP Highway Study contract, supported by bilateral assistance teams for the most important transport sectors.

2.22 Improvements in transport coordination are certainly required, particularly in investment analysis, pricing policies and institutional arrangements. It will, however, take time to develop suitable policies and it would not be justified to delay urgent investments for highways until relative priorities in the transport sector as a whole are established and a comprehensive transport coordination policy is available. During negotiations, however, the Government was advised that the Bank Group would wish to discuss overall transportation policies before entering into further commitments to finance transportation investments in Indonesia, and that recommendations of the Transport Coordination Advisory Team should meanwhile be taken into consideration by Government when formulating such policies.

### 3. THE HIGHWAY SYSTEM

#### A. General

3.01 The public highway system is classified into "national", "provincial" and "county" roads, (the latter known also as "district" or "village" roads); this classification, indicative of the relative importance of the roads, is used as a basis for defining administrative, financial and executive procedures associated with road construction and maintenance. The national roads, totalling about 10,000 km, are the country's trunk routes; the provincial roads, totalling about 22,000 km, are the main routes of the 26 Provinces; and the county roads, totalling about 50,000 km, comprise all the remaining public roads. In addition, estates and plantations construct and maintain roads outside the public highway system. The extent of the system, by Province, and an indication of the areas and population served, are given in Table 1. The theoretical load-carrying capacity of the system, expressed in terms of permissible axle-loads, is given in Table 2.

3.02 About 15,000 km of the 82,000 km which comprise the public system are paved, the greater part of the paving being on national and provincial roads (Table 3). These paved roads, most of which were constructed many years ago, have stone bases which have served the pavements well in recent years of neglected maintenance. But maintenance is still almost non-existent and the paved roads are deteriorating quickly.

3.03 The most serious defect along thousands of kilometers of paved roads is the inadequacy of surface drainage; earth shoulders are higher than the pavements which they should drain, and side ditches, which should receive surface water from the shoulders and which should help to control moisture beneath the pavement, are also too high, or are blocked with debris, or both. These defects are serious in that they produce soaked pavements and thus accelerate ultimate break-up. The stronger pavements have so far resisted complete disintegration, although incipient failure, due in large measure to these drainage defects, is widespread. The less robust pavements have already yielded to neglected maintenance and have become gravel or stone roads, generally difficult for vehicles to negotiate.

3.04 Unpaved roads form the greater length of each class of road, and the bulk of the county roads (Table 3). These roads would normally be maintained by motor grader but the dearth of maintenance equipment, notably of graders, has resulted in most of the roads becoming pot-holed and rutted tracks. Trip speeds of no more than 15 km/h are common on roads in this condition.

3.05 Bridges are usually made of masonry, concrete or steel construction with a concrete deck, and are frequently single-width only. Lack of maintenance over recent years has chiefly affected the steel bridges; many are corroded to the point of danger, some have collapsed, (this is particularly true in Sumatra), and when no replacement has been made the approach roads, no longer trafficked, have reverted to over-grown tracks.

## B. Highway Traffic

3.06 The development of traffic on Indonesia's roads is difficult to assess, since 90% of the road transport industry consists of one-vehicle enterprises, and the Government collects few data on the industry. Comprehensive and comparable traffic counts have not been undertaken for about 10 years.

3.07 In 1967, the road transport fleet totalled about 300,000 vehicles, the majority gasoline-powered, and comprised about 185,000 cars, 18,800 buses and 95,000 trucks; more than 2/3 of the entire fleet was in Java (Tables 4 and 5). The average capacity of the trucks is small and certainly does not exceed 3.5 tons. The age of the fleet (half of the vehicles are more than 10 years old) and the estimated 75 different makes of vehicle in the country lead to difficulties in procuring spare parts and to vehicles being off the road as a consequence. Estimates of the inoperative part of the registered fleet vary from 30% to 50%. In the Five-Year Plan, for instance, it is assumed that the operative truck fleet in 1968 consisted of about 47,000 units only, of which about 25,000 were used as public transport.

3.08 It is estimated that the operative private truck fleet carries about 7 billion ton-km annually; this would imply an average load of 2.5 ton and an annual average mileage of 60,000 km per operative vehicle. Vehicles of the Armed Forces participate in the road transport market, but no reliable information is available on this traffic; it is not unreasonable to assume however, that Armed Forces vehicles carry an additional 2 billion ton-km p.a. so that total goods transport by road would be about 9 billion ton-km p.a.

3.09 Uncertainty about the participation by Armed Forces and about the size of the operative fleet in private hands makes it impossible to reconstruct time series for the development of traffic. Traffic growth must have been minimal or close to zero during the past years of economic stagnation and of deterioration of the road system and vehicle fleet. This conclusion is supported by the available data on fuel consumption between 1962 and 1968 (Table 6).

3.10 During January/February 1969, the consultants, with the cooperation of the central and provincial works organizations, conducted traffic counts on about 900 important road links, covering all national roads and about 50% of the provincial roads. Although such "spot" counts do not permit the establishment of estimates of total traffic or its regional distribution, they provide adequate data on traffic densities on particular roads. The counts reveal that in Java about one-third of the links have traffic volumes of more than 1,000 vpd, that a significant number carry more than 5,000 vpd, and that only a negligible number carry less than 200 vpd. On Sumatra highest densities are found in the provinces of North Sumatra, West Sumatra and Lampung; traffic volume is typically several hundred vpd, but seldom exceeds 1,000 vpd. On Sulawesi, the North and South provinces have a traffic pattern similar to that found in Sumatra while in the two central provinces traffic rarely rises above 100 vpd. Regular counts should now be undertaken by Government on these and other important roads to provide the information necessary for rational planning of road maintenance and development. An assurance to this effect was obtained during negotiations.

3.11 On the whole, in Indonesia, vehicle operation is expensive; freight rates are, therefore, high by international standards. Typical provincial tariffs are Rp. 10 (US\$3)/ton-km in Java and Bali, Rp. 15 (US\$5)/ton-km in Sumatra and Rp. 20 (US\$6)/ton-km in Sulawesi, but truckers tend to adjust rates to market conditions and costs, particularly where the latter are unusually high because of poor road conditions (see Chapter 5).

3.12 Road transport regulations relate only to standards for weight and size, vehicle condition, etc., but are not rigorously enforced. Load factors are generally high, on average exceeding 60%, but overloading is widespread and contributes to the deterioration of the roads and endangers the bridges. A national policy on vehicle weights and dimensions is being determined by the consultants; an assurance was obtained during negotiations that the consultants' recommendations will be taken into consideration in the formulation of policy on this issue.

#### C. Administrative and Financial Procedures

3.13 Administration of the public road system follows the three tiers of the classification of the roads: national roads are the responsibility of central government (in practice, this responsibility is delegated to the Directorate-General of Highway Construction); provincial roads, of the provincial administrations; and county roads of the district administrations. The Directorate-General of Highway Construction is part of the Ministry of Public Works and Power (MPW), which includes, among other branches, the Directorates-General of Irrigation and of Housing and Building (see Chart). This aggregation of functions within the MPW is repeated at provincial level where provincial works organizations are responsible for roads, irrigation and buildings. While this type of organization may not be ideal in a program designed to focus specifically on the highway system, it is acceptable, at least in the short term, and has the merit of economy of common services, such as offices, workshops, administrative personnel, at a time when these services are scarce.

3.14 Financing of road works is normally the responsibility of the organization administratively responsible for the roads, funds for new work and maintenance being met from the development and recurrent budgets, respectively, at each administrative level. Exceptionally, central government finances construction of provincial roads when they are of national or inter-provincial importance; provincial governments may finance county road construction on a similar basis. Provincial budgets are supported in part directly by the export earnings of the provinces themselves; this makes for considerable autonomy on the part of the provinces in highway matters.

#### D. The Highway Budget

3.15 The volume of construction of national highways since 1963 has been small, much of it being confined to the periphery of Djakarta. Expenditures are difficult to assess accurately because of currency inflation,

but MPW figures, adjusted for inflation, indicate that the cost of all construction on national highways during 1963 - 1967 was about US\$15 million equivalent, a very small amount. No figures are available for construction of provincial and county roads during this period.

3.16 The consultants for the Highway Services, as a result of their inventory (para. 1.02), estimate that about 12,500 km of roads throughout the country require rehabilitation, at an estimated cost of Rp. 37.2 billion (US\$112 million). The budget of the Directorate-General of Highway Construction for the financial year 1969/70 includes Rp. 1.6 billion (US\$4.7 million) for rehabilitation and Rp. 3.9 billion (US\$11.6 million) for upgrading; this budget was, of course, prepared before the consultants' rehabilitation program was available. No provincial budgets are available so far. An assurance was obtained at negotiations that, as far as practicable, rehabilitation work, both on national and provincial roads, would accord with the priorities determined by the consultants.

3.17 Maintenance allocations, for all classes of roads, relate, in effect, only to the cost of materials used; equipment depreciation under present accounting procedures is not charged to work, and the personnel employed, even the laborers, are civil servants whose salaries are considered a debit to general administration rather than to specific road works. The consultants estimate that annual maintenance allocations for national and provincial roads are of the order of US\$40/km. Allowing for typical equipment depreciation charges and for labor, the true allocation may be about US\$150/km; but even this figure, for the national and provincial roads, is inadequate by modern standards; furthermore, under present accounting procedures, it is not possible to determine how effectively the present allocations are used. Typical maintenance requirements/km for all classes of road are being determined by the consultants as part of the Highway Services. An assurance was received during negotiations that maintenance allocations for the project roads would be based on the consultants' findings.

#### E. The Planning and Engineering of Highway Work

3.18 Selection of construction work on national routes is the responsibility of the Bureau of Planning, part of the Secretariat of the MPW (see Chart). Detailed investigation and engineering are the responsibility of the Directorate-General of Highway Construction and are normally carried out within the department. Planning and engineering on provincial roads are carried out either by the MPW, as above, or by the provincial works organization, depending on the complexity of the work and availability of staff. Very occasionally, foreign consultants are used, the most recent example being the engineering of the Djakarta by-pass, 1963 - 1965.

3.19 The capacity for planning and engineering is severely limited by the lack of professional and technical staff of all disciplines. The consultants' inventory of personnel shows, for example, that the Planning and Survey Directorate of the Directorate-General of Highway Construction (see Chart), responsible for detailed planning of national road works throughout

the country has only 20 civil engineers. At provincial level there are about 20 professional engineers per province in Java and less than 10 per province in the remainder of the country, but these provincial engineers are responsible for buildings and irrigation works as well as for work connected with the highway system. This paucity of professional and technical staff is partly a result of the low output of engineers and technicians from the training institutions, (only about 120 engineering graduates are available each year for both the public and private sectors). Work and pay conditions are also important factors.

3.20 Shortage of planning and engineering staff is one of the major constraints on the size of the program in the highway sector which could be undertaken by the central and provincial works organization. The Highway Services, extending through the end of 1970, and the technical support proposed under the project, provide a measure of relief in the short term, but if the benefits of the proposed project and of future projects are to be maintained in the long term, Government should now seriously consider how the output of trained staff may be increased and how positions within the planning and engineering functions may be made more attractive. An assurance that Government would take all steps necessary in this respect was obtained during negotiations.

#### F. The Execution of Highway Work

3.21 Construction and maintenance are normally carried out by departmental forces, but if the volume of new work is beyond departmental capacity at any time, the excess is executed by contract. Most contracting firms are government-owned; there are a few private indigenous contractors who lease the necessary equipment from government. Exceptionally, and again in the case of the construction of the Djakarta by-pass, foreign contractors are used.

3.22 Effective construction and maintenance work requires (i) adequately trained personnel; (ii) the appropriate equipment, well maintained; (iii) ample supplies of materials; and (iv) administrative procedures for planning and controlling the work. Materials are readily available within the country or can be imported without difficulty, but the three remaining factors impose constraints on the amount and quality of work which can be executed, as discussed in the following paragraphs.

3.23 The consultants' inventory discloses a scarcity of executive engineers for highway construction and maintenance works; for example, the Directorate of Construction in the Directorate -General of Highway Construction (see Chart) has only 35 professional engineers for its nation-wide operations. As in the case of planning and engineering staff (para. 3.20), an assurance was obtained during negotiations that action would be taken to **increase the** number of executive engineers.

3.24 The inventory discloses an almost complete absence of operational construction and maintenance equipment. Equipment has been obtained from many countries over the years and spare parts for much of it are now difficult

to procure; it therefore lies idle on the roads or in the workshops and is soon cannibalized. The workshops, particularly in the provinces, have old equipment and an almost complete lack of hand tools, and they are not suitable for the maintenance and support of modern equipment. Inventory procedures for procuring, issuing, controlling and costing spare parts are virtually non-existent. The project includes provision of construction and maintenance equipment, rehabilitation of workshops and implementation of appropriate inventory procedures.

3.25 Accurate job costing forms the basis of planning and of works control, but currently neither highway construction nor maintenance operations are properly costed. Material and labor costs could readily be obtained but with the existing accounting procedures it is not possible to determine the true cost of using equipment, or additionally to benefit from the discipline which costing provides for those responsible for the efficient use of equipment. As part of the Highway Services, the consultants will determine the procedures for costing labor, materials, and equipment appropriate for Indonesian conditions. The project includes implementation of these procedures and provides for assistance during the introductory period.

#### G. The Role of the Army in Highway Work

3.26 The Army has a large amount of highway construction and maintenance equipment; it is also a source of engineering expertise additional to that of the works organizations. Holding units ready for emergency operations, such as those caused by flooding or earth-quakes, has first call on the Army's engineering capability, but beyond this need there is a considerable potential of engineering equipment and expertise that could be used on works of economic importance.

3.27 Army engineering units, notably the heavily-equipped construction battalions, are already participating in the Five-Year Plan on road and irrigation works. The more lightly-equipped engineer combat units could, however, also play a useful role; these units are well suited, for example, to carrying out the technically simple but important work necessary to remedy the drainage defects on highways (para. 3.03). Tentative agreement was reached with the Army authorities, during appraisal, that engineer units surplus to operational requirements would be employed, outside the scope of the project, on road work of high economic priority. This agreement was confirmed with the Government during negotiations.

#### 4. THE PROJECT

##### A. Description and Purpose

- 4.01 The project comprises:
- (i) a four-year program to rehabilitate 109 high-priority roads, totalling about 3,000 km, in five provinces;
  - (ii) a four-year program to improve routine and periodic maintenance over the road network in 20 provinces, including the five in (i) above;
  - (iii) the rehabilitation of workshop facilities in the 20 provinces;
  - (iv) **four-year** pilot training and experimental programs, in three provinces, for all aspects of highway work;
  - (v) the implementation of stores inventory and works costing procedures;
  - (vi) the provision of technical experts to support the above operations;

and includes the procurement of equipment, materials and services therefor.

4.02 The purpose of the project is four-fold: (a) to rehabilitate high-priority national and provincial roads; (b) to reduce the general deterioration of the highway system by improved maintenance and thus to postpone the need for investment in new construction; (c) to provide the necessary administrative and technical organization for this project and for future rehabilitation and development of the highway system; and (d) to provide training facilities for all aspects of highway work and administration. Although Indonesia comprises 26 provinces, (Table 1), in six the highway rehabilitation and maintenance needs are not significant; improvement of maintenance, and rehabilitation of workshop facilities ((ii) and (iii) above) would therefore be limited to the remaining 20 provinces (see Map).

##### B. Rehabilitation of High-Priority Roads

4.03 The consultants' study (para. 1.02) provides a basis for selecting national and provincial highways, the rehabilitation of which would produce large economic benefits. Such roads are located in virtually all provinces, but particularly in those of Java, Sumatra and Sulawesi.

4.04 The rehabilitation program is defined on a provincial basis since works organizations, albeit of varying efficacy, already exist at that level and the consultants' organizational studies to date indicate that development and strengthening of provincial works organizations is a desirable aim.

Financial and organizational constraints, however, preclude rehabilitation of all high-priority roads in all provinces at this time.

4.05 The project includes rehabilitation in five provinces, (East and West Java, South and West Sumatra and South Sulawesi), (see Map), the selection being based on the need to rehabilitate the maximum length of road and on the desirability of achieving the widest possible impact throughout the country, compatible with the above-mentioned constraints. Rehabilitation of high-priority roads in other provinces forms part of a larger program, which includes the proposed project. Rehabilitation under the project would be carried out on a provincial basis by "matched" teams; it would range from minor patching and sealing to replacement of failed bituminous pavements and would include the correction of grade and compaction of shoulders and the rehabilitation of surface-water drainage. Bridge rehabilitation, usually cleaning and painting of steelwork, repair of damaged decks and guard rails, etc., would be included in the work. Exceptionally, dangerous bridges which could not economically be made safe, would be replaced; the replacements would be temporary steel structures since in most instances the optimum alignment of the highway has not yet been determined.

4.06 The project includes the procurement of equipment and materials necessary for this rehabilitation program. An indication of the total equipment requirements per province is given in Table 7.

#### C. The Improvement of Routine and Periodic Maintenance

4.07 Due largely to lack of equipment, materials and expert personnel, routine and periodic road maintenance over most of the country is virtually non-existent; roads, particularly paved roads, are therefore deteriorating rapidly. Resumption of basic maintenance operations is urgently required if further deterioration is to be avoided.

4.08 In all of the 20 provinces which have significant highway problems, including the five in which rehabilitation will be carried out (see above), a major effort would be mounted as part of the project to resume essential maintenance operations. The project would provide essential equipment, (typical items are indicated in Table 8), also technical expertise to assist in the field and in the workshops (para. 4.18) and the necessary procedures to cost and control the work (para. 4.16).

#### D. Rehabilitation of Workshop Facilities

4.09 Adequate workshop facilities are a pre-requisite for effective road maintenance and construction. Existing workshop facilities comprise, on average, one workshop per province but the consultants' inventory reveals that most of this workshop equipment is dilapidated beyond the point of economic repair, and equipment which is operative is old and unsuitable for modern maintenance tasks. Although workshop buildings are adequate or could be made so without major effort, workshop areas are badly drained and are generally cluttered with equipment which has only a scrap value. The road access to many of these provincial workshops is difficult.

4.10 The appropriate organization of workshop facilities, at all levels, has been investigated as part of the Highway Services. From their investigations, the consultants deduce that while the provincial workshop should retain its role, it should in future be limited to component exchange and to repairs of lesser complexity, and that component repair and major overhauls should be carried out only at specially equipped "base" or regional workshops. USAID has agreed to provide the equipment for five such regional shops, two in Sumatra (at Padang and Palembang), two in Java (at Surabaya and near Bandung) and one in Sulawesi (at Makassar) and to provide supervisory staff for their operation, certainly for one year, possibly for two. The location of the shops and their scale of equipment has been agreed between USAID and the consultants for the Highway Services; the shops would be under the control of the Directorate of Equipment Supply, part of the Directorate-General of Highway Construction (see Chart). USAID has already allocated funds for this equipment and procurement is scheduled before June 1969. The five regional shops are expected to be operational early in 1970.

4.11 The project, therefore, concentrates on rehabilitation of workshop facilities at provincial level and includes (i) the removal of all scrap and obsolete material from the workshops and workshop areas; (ii) the improvement of access to and drainage of these areas; (iii) the repair of workshop buildings as necessary; (iv) the provision of equipment for the provincial workshops; and (v) the provision of mobile servicing units. Assistance in running the rehabilitated facilities would be provided under Technical Support (para. 4.18). The scale of equipment to be provided in each of the 20 provinces is indicated in Table 9.

#### E. Pilot Programs

4.12 The terms of reference for the Highway Services require the consultants to give support to the highway organizations, to prepare pilot programs for such support and to participate in their operation. Based on the preliminary finding of the consultants, the project includes the establishment and operation of pilot programs in three provinces for a period of four years. The function of the schemes would be three-fold: (i) to train personnel of all levels and disciplines connected with highway construction, maintenance and administration; (ii) to develop and evaluate techniques, most appropriate to the specific region, for highway planning, construction, maintenance and administration; and (iii) to record these techniques in the form of operational manuals.

4.13 The pilot provinces would be North Sumatra, West Java and South Sulawesi. Whereas for operational reasons the pilot provinces in Java and Sulawesi would correspond with provinces chosen for the rehabilitation program, such would not be the case in Sumatra. This would, however, be an advantage since the project would then have a major impact in three Sumatran provinces, two selected for the rehabilitation program and the third as a pilot province.

4.14 Personnel for operating the pilot schemes would be drawn from the central and provincial works organizations, supplemented, through the end of 1970, by the consultants for the Highway Services and by the Technical Support to be provided under the project, (para. 4.18). In the case of Java and Sulawesi, the rehabilitation program in the provinces in question would provide the operational background for the pilot schemes. In the case of Sumatra, which would not have the support of a rehabilitation program, additional equipment would be allocated to the province by reallocation within the national equipment pool.

#### F. Implementation of Inventory and Costing Techniques

4.15 Inventory and costing methods most appropriate to the needs of the central and provincial works organizations will be defined as part of the task of the Highway Services. In detail, the consultants will define:

- (i) the inventory system to be used;
- (ii) inventory control and re-ordering techniques;
- (iii) the form of job costing for personnel, materials, equipment, workshop facilities and spares;
- (iv) the system of construction control using works budgets; and
- (v) the procedure for using equipment depreciation charges as a basis for financing equipment renewal.

4.16 The project includes implementation of these inventory and costing techniques and provides for expert assistance during the introductory stage and for the supply of inventory control and costing equipment. Further assistance, both at central and provincial levels, would be provided as part of the Technical Support (see below).

#### G. Technical Support

4.17 Because of a shortage of personnel within the works organization and also because of the novelty of much of the equipment and methods which would be introduced, effective implementation of the project would not be possible without large-scale technical support. The project includes such support therefore, both at central and provincial levels, for the first two years of the project period. The possible need to continue this assistance in the latter two years of the program may have to be considered in future projects.

4.18 In detail the technical support comprises: (i) two experts in each of the 20 provinces which have significant road networks, one to assist in the field, the other in the workshop; (ii) five quarrying experts, one to be attached to each of the provincial rehabilitation teams; (iii) three engineer geologists/materials engineers, one per region, to assist in the location and evaluation of sources of materials; and (iv) a directing and coordinating team comprising a highway engineer (who would be team leader), a mechanical engineer and a costing/accounting expert. The provincial experts ((i) above) would additionally assist in the implementation of

costing and inventory methods at provincial level, and the engineer geologists, ((iii) above) would additionally assist in the instructional aspect, particularly in connection with material evaluation, of the pilot programs. Details are given in Table 10.

H. Cost Estimates, Project Financing and Credit Disbursement

4.19 The project would require capital expenditures of US\$46.7 million equivalent of which the Bank would finance US\$28 million, representing the foreign exchange cost of all imported equipment, materials and expatriate personnel required for the project. Government has agreed to finance the balance of the capital expenditures. Details of capital expenditures are as follows:

<u>Capital Expenditure</u>	<u>Indonesian Rupiahs</u> (million)			<u>US\$</u> (million)		
	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	<u>Local</u>	<u>Foreign</u>	<u>Total</u>
Four-year road rehabilitation program (new equipment and spares, materials and labor)	5,321	4,629	9,950	16.3	14.2	30.5
Four-year road maintenance program (new equipment and spares)	-	1,826	1,826	-	5.6	5.6
Rehabilitation of workshop facilities (new equipment)	65	391	456	0.2	1.2	1.4
Pilot programs (new equipment)	65	33	98	0.2	0.1	0.3
Inventory and costing procedures (new equipment)	-	33	33	-	0.1	0.1
Technical support (personnel)	<u>261</u>	<u>1,630</u>	<u>1,891</u>	<u>0.8</u>	<u>5.0</u>	<u>5.8</u>
	5,712	8,542	14,254	17.5	26.2	43.7
<u>Contingencies</u>	<u>391</u>	<u>587</u>	<u>978</u>	<u>1.2</u>	<u>1.8</u>	<u>3.0</u>
Total of capital expenditure	6,103	9,129	15,232	18.7	28.0	46.7

4.20 Government has agreed to finance all recurrent expenditure required in connection with the project, estimated at Rp. 3,100 million over the four-year project period; this agreement was also confirmed during negotiations. Details are as follows:

<u>Recurrent Expenditure</u>	<u>Indonesian Rupiahs</u> (million)
Labor and materials for maintenance	2,500
Operation of workshop facilities	540
Operation of inventory and costing procedures	<u>60</u>
Total of recurrent expenditure	3,100

The foreign exchange element of recurrent expenditures has not been estimated separately. The Provinces, with the technical support referred to in paras. 4.16 and 4.18, would keep an account of equipment cost, including depreciation, during the project period.

4.21 The estimated cost of the rehabilitation program has been based on preliminary quotations for the supply of equipment, and on unit costs for items of rehabilitation work compiled by the consultants; in the absence of meaningful local costs, the consultants have drawn on their experience of similar work in comparable conditions elsewhere. These unit costs appear realistic.

4.22 The estimated cost of equipment for the road maintenance program has also been based on preliminary quotations. In the absence of realistic maintenance costs, the recurrent cost of the four-year maintenance program has been based on the consultants' provisional recommendations for unit maintenance allocations for different types of road.

4.23 The cost of the rehabilitation and operation of workshop facilities has been based on preliminary quotations for equipment, on estimates for repairs to existing buildings and on tentative staffing requirements. Estimates of cost for the pilot programs and for the implementation of inventory and costing procedures have been based chiefly on the cost of the equipment required, (testing and surveying equipment for the pilot programs, processing equipment for the inventory and costing procedures). The estimate of cost for the technical support has been based on rates obtaining in the current Highway Services.

4.24 Disbursement under the proposed credit would be made generally on the basis of 100% of the c.i.f. cost of imported equipment and materials required for the project net of all taxes and local charges, and of the foreign exchange payments made to the consultants providing the technical support. Assuming that the credit would be signed about June 1969, annual requirements of foreign currency under the credit would be as follows:

Bank/IDA financial years	<u>1969/70</u>	<u>1970/71</u>	<u>1971/72</u>	<u>1972/73</u>	<u>Total</u>
Amount (US\$ million)	16.4	9.1	1.9	0.6	28.0

In the event of savings under the credit, consideration should be given to procurement of additional road maintenance equipment to be agreed at the time between the Government and the Association.

#### I. Project Execution

4.25 The project is expected to be completed in about four years, the critical element being the rehabilitation program. The authority responsible for project execution would be the Directorate-General of Highway Construction.

4.26 Procurement of equipment and materials would be phased. After workshops are cleared and repaired, first priority would be procurement of workshop equipment, implementation of stores and inventory procedures and retention of consultants for technical support. Thereafter, with workshops operational and inventory procedures effective, equipment for the rehabilitation and maintenance programs would be procured. All equipment and materials, with the exception of hand tools for the workshops, would be procured under standard Bank/IDA procedures. In the interests of speedy rehabilitation of the workshop facilities, hand tools for the workshops, estimated to cost in total about US\$75,000, would be procured by local competitive bidding.

4.27 Providing that a satisfactory contract could be negotiated between the Government and the consultants, experts for the technical support would be provided by KAMPSAX/Berger, the firm currently carrying out the Highway Services. Such a contractual arrangement would have the advantages (a) that in the period before the end of the Highway Services (scheduled to terminate at the end of 1970), the operations of the Services and the technical support could be integrated under the direction of a single firm; (b) that in the period after the end of the Highway Services the technical support contract would provide the means whereby key personnel working under the Services, whom it may be desirable to retain for a further period, could be transferred between contracts without interruption of the services on site.

4.28 Procurement, receipt, issue and accounting of equipment and spares would be the responsibility, at national level, of the Directorate of Equipment Supply (part of the Directorate-General of Highway Construction - see Chart) which would be augmented for the task from within the MPW, and which would receive additional assistance from the experts provided under the Highway Services and under the proposed technical support. At provincial level these operations, also the rehabilitation and running of workshops, would be the responsibility of the provincial works organizations assisted by the experts assigned to the workshops in each province under technical support.

4.29 The road rehabilitation program in the five selected provinces would be executed departmentally, since the work, by its nature being widely scattered and not easily quantifiable, is unsuitable for normal contract procedure. The staff in the provinces selected would be augmented as required for the execution of the program by reallocation of personnel within the central and

provincial works organizations, and would be assisted by the experts provided under the proposed technical support. The maintenance program would be executed by the provincial works organizations, likewise assisted by the proposed technical support, Costing of all work, both in the workshop and on site, would be introduced progressively in all 20 provinces covered by the project.

4.30 The pilot programs, currently being formulated as part of the Highway Services, would be executed by the works organizations of the three provinces selected, augmented as necessary from within the central and provincial work organizations. The programs would be supported initially by the consultants for the Highway Services and later by the technical support provided under the project.

## 5. ECONOMIC JUSTIFICATION

### A. General

5.01 The tasks facing Indonesia in the transport sector are to prevent the further deterioration of a basically well planned and generally adequate network, to improve the managerial and operating efficiency of the principal agencies involved and to make some new investments to meet particularly pressing needs. Since the resources, capital and human, to achieve these objectives are limited, a careful ordering and balancing of priorities is necessary. The Government has decided to put the greatest emphasis on rehabilitating the road system and improving managerial and executive capacity in the railways, ports, etc. This priority to the road sector is appropriate for at least two sound economic reasons. First, deteriorating road conditions, by increasing transport costs, inhibit the marketing of agricultural produce; in some cases the physical deterioration of roads has gone so far as to cut off producing areas from their markets entirely. Secondly, if increased expenditures are not made on the road system, it will physically deteriorate at an increasing rate and result in both earlier and greater capital investment for reconstruction.

5.02 In addition to investments in equipment for rehabilitation and maintenance, the project includes technical and organization support by consultants to the highway administration. It is not possible to attribute any direct benefits to the expenditures for these consultants' services. They are, however, fundamental to the provision of executive capacity, without which this project and future rehabilitation and development could not be undertaken.

### B. Rehabilitation

5.03 The immediate objective of the proposed project is to rehabilitate 109 road sections totalling about 3,000 km, or one-quarter of the total length included in the national road rehabilitation program that has been prepared by the consultants, KAMPSAX/Berger. For purposes of the economic evaluation, rehabilitation costs have been assessed to include an allowance for equipment depreciation, expenditures for labor and materials, and administrative overheads. Accordingly, rehabilitation costs for the roads included in this proposed project would be Rp. 9.23 billion or US\$28.3 million equivalent, while the total estimated cost for the larger and longer run national road rehabilitation program is estimated to be Rp. 37.2 billion or US\$114 million equivalent.

5.04 These overall rehabilitation needs of Indonesia's road system are so large that rational phasing and concentration of effort are essential. The project, therefore, concentrates on immediate rehabilitation work in the five provinces, West and East Java, South and West Sumatra and South Sulawesi, in which the amount of rehabilitation work on roads of highest

priority is sufficiently big to ensure full utilization of large equipment teams. These teams are not divisible without incurring substantial diseconomies of operation.

5.05 The average daily traffic on the road sections selected for inclusion in the project is generally in the higher category of traffic densities. However, the project does include a number of roads which at present have little or no traffic; these roads which were formerly of local importance, generally for agriculture, are now so difficult to negotiate as to be almost, if not entirely, impassable. On these roads traffic generation can be expected in the first year after road rehabilitation since production surpluses are available for marketing. On most of the other roads normal traffic growth is expected to be resumed with the recovery of the economy. Taking into account the economic potential of specific regions, the consultants have estimated that this normal growth of traffic will usually be between 5 and 7% p.a. In the view of the Resident Staff in Indonesia, these estimates are reasonable.

5.06 The cost of road transport in Indonesia is unquestionably high. This, among other things, is due to the use of vehicles with small load capacities. An analysis is currently being undertaken by KAMPSAX/Berger to see whether it would be economical to increase the load capacity of the existing road system substantially in the future. In the meantime, significant benefits can be obtained merely by repairing existing roads. The benefits attributed to the project, therefore, are only savings in vehicle operating costs from the improvement of pavement conditions. In the course of making the highway inventory, the consultants have classified all road links, according to surface condition, in five major groups for each pavement type. Tables 11 and 12 show the cost of operating average size (3.5 t) trucks and cars on good surfaces. The costs (excluding taxes) per vehicle-km of Rp. 20.5 (US\$6.3) for trucks and buses and Rp. 7.3 (US\$2.2) for cars relate only to surface conditions and do not take account of other factors such as gradients, degree of curvature, etc.

5.07 Tables 13 and 14 show how these operating costs per vehicle-km vary with the different surface conditions; for example, on very poor quality asphalt roads (Condition 5) the operating cost for trucks has been estimated by the consultants at Rp. 51.4 (US\$15.8). The priorities of rehabilitating particular roads were derived on the basis of first year benefit-cost ratios; these ratios compare rehabilitation costs with the benefits accruing in the year immediately after completion of the investment by improvement from one surface condition to another. In those cases where traffic is minimal or has stopped, the net added value of generated goods traffic has been taken as the primary benefit.

5.08 This method is acceptable for priority ranking and for making a preliminary selection of roads for investments. There are about 6,000 km of roads in Indonesia for which the benefits in the first year exceed half the investment costs. However, due to financial and administrative constraints, the project is limited to five provinces and covers about 3,000 km of these roads.

5.09 For purposes of the economic analysis of the roads in the project a comparison of costs and benefits over a period of seven years has been undertaken. This period corresponds to the time interval between the need for rehabilitation now and the likely time in the future for major improvement or reconstruction. In the present conditions of Indonesia, it is extremely difficult to associate particular levels of vehicle operating costs with each category of road condition; available data are scarce and unreliable. When the surface of an asphalt road is corrugated or so completely broken up that truck speeds do not exceed 15 km/h, the cost of operating a vehicle becomes extremely high and, indeed, may be double the cost of operating on a normal asphalt pavement. While there is no information available to question the potential savings which the consultants attribute to rehabilitating roads in particular conditions (see Tables 13 and 14), it is considered prudent to reduce them by an arbitrary 50% to provide a measure of safety which eliminates the risk of over-estimating the benefits.

5.10 This substantial reduction in benefit estimates does not alter the basic justification of the project. The internal rates of return for the investment exceed 15% in all cases, and the weighted average rate of return for the investments on 109 road sections is over 40%. Rehabilitation of the roads selected is therefore clearly justified.

### C. Maintenance

5.11 The project also provides for the acquisition of maintenance equipment for 20 provinces at a total cost of US\$5.6 million. This will permit resumption of normal maintenance operations on about 5,000 km of roads which are either not maintained or are under-maintained. The provincial highway administration will select the particular road sections involved under guidance from the technical advisors to be appointed as part of the project.

5.12 The benefits to be expected from the expenditures for maintenance consist mainly of reductions in vehicle operating cost, which depend on present surface conditions and traffic volumes of particular roads selected. Experience by the Bank Group with maintenance projects in other countries shows that improved maintenance generally results in reductions of vehicle operating costs of at least 15%. This does not take account of any increase in existing vehicle operating costs which would result if maintenance operations were continued with the present limited equipment and inefficient techniques, and which as a result of the project expenditures will be avoided.

5.13 The internal rates of return on the investments for improved maintenance would exceed 20% in those cases where traffic volumes exceed 200 vehicles per day. Since most of the roads which would be maintained carry more than 200 vehicles, the proposed investments for improved maintenance are considered adequately justified. The proposed investment of US\$5.6 million in any case, represents only about 7% of the country's ultimate requirement for highway maintenance equipment.

5.14 There is room for additional refinement in methodology and data, but more exact quantification of the rate of return on the project would require costly and time-consuming research on vehicle operating costs, maintenance expenditure and investment costs for future reconstruction and improvements. While the present analysis does not fully assess the rate of return on the project, it demonstrates, based on the available data, the urgency of the proposed investments. In view of the high returns, it would not be economical to await the results of more refined research while the erosion of a significant amount of capital in Indonesia's roads continues.

## 6. RECOMMENDATIONS

6.01 During credit negotiations agreement was reached on the following principal points:

- (i) the need to consider the recommendations of the Transport Coordination Advisory Team when formulating transport policy, (para. 2.22);
- (ii) the need to schedule rehabilitation, throughout the country, generally in accordance with the priorities established by the consultants as part of the current Highway Services, (para. 3.16);
- (iii) the need to base allocations for maintenance of national and provincial roads on the consultants' recommendations, (para. 3.17);
- (iv) the need to attract and retain additional trained staff for the planning, engineering and execution of highway work, both in the central and provincial works organizations, (paras. 3.20 and 3.23);
- (v) the need to utilize Army engineer units, surplus to operational requirements, on road work of high economic priority which is outside the scope of the project, (para. 3.27).

6.02 The proposed project provides a suitable basis for a credit of US\$28 million equivalent to the Government of Indonesia.

June 3, 1969

INDONESIA-HIGHWAY PROJECT

1)  
THE PUBLIC HIGHWAY SYSTEM (July 1968)

Region	Area		Population (1968)		Province	National Roads (km)	Provincial Roads (km)	County Roads (km)	Total (km)			
	by region (km <sup>2</sup> )	% of national area	by region (millions)	% of national population								
J a v a	132,000	7	74.8	65.0	(Djakarta)	-	450	-	27,800			
					(West Java)	620	1,850	4,970				
					(Central Java)	410	1,800	6,680				
					(Jogjakarta)	30	110	740				
					(East Java)	520	2,690	6,930				
					1,580	+	6,900	+	19,320	-		
Sumatra	474,000	25	18.6	16.2	(Atjeh)	490	1,040	3,540	28,420			
					(North Sumatra)	790	2,390	3,540				
					(West Sumatra)	570	1,080	1,890				
					(Riau)	90	660	810				
					(Djambi)	430	570	610				
					(South Sumatra )	660	3,470	2,760				
					(Bengkulu )							
(Lampung)	240	510	2,250									
					3,270	+	9,720	+	15,430	-		
Kalimantan (Indonesian Borneo)	539,000	28	4.8	4.2	(West Kalimantan)	450	990	500	5,210			
					(Central Kalimantan)	80	80	50				
					(South Kalimantan)	280	490	1,800				
					(East Kalimantan)	200	220	70				
											1,010	+
Sulawesi (Celebes)	189,000	10	8.4	7.3	(North Sulawesi)	720	380	80	11,850			
					(Central Sulawesi)	600	610	3,420				
					(South Sulawesi)	580	1,230	2,180				
					(South-East Sulawesi)	190	240	1,620				
											2,090	+
The Principal Smaller Islands	94,000	5	7.5	6.5	(Bali)	390	310	1,050	7,780			
					(West-Musa Tenggara)	490	70	1,710				
					(East-Musa Tenggara)	1,230	340	1,350				
					(Maluku)	80	220	510				
											2,190	+
West Irian (Indonesian New Guinea)	422,000	22	0.9	0.8	West Irian	-	880	-	880			
<b>TOTAL</b>	<b>1,850,000</b>	<b>97 2/</b>	<b>115.0 3/</b>	<b>100.0</b>		<b>10,140</b>	<b>+</b>	<b>22,680</b>	<b>+</b>	<b>49,420</b>	<b>-</b>	<b>81,940</b>

Notes 1/ Excluding municipal roads (totalling about 2,000 km).

2/ The total land area of Indonesia, including numerous smaller islands not in the above grouping, is approximately 1,904,000 km<sup>2</sup>.

3/ Population figures derived by applying the estimated annual growth rate of 2.1% to the 1961 census figures.

Sources: Area & population statistics: "INDONESIA, FACTS & FIGURES" - Indonesian Academy of Statistics (1967).  
Highway statistics: Directorate-General of Highway Construction, Ministry of Public Works & Electric Power.

April 29, 1969

TABLE 2

INDONESIA - HIGHWAY PROJECT  
THE PUBLIC HIGHWAY SYSTEM  
DESIGN LOAD-CARRYING CAPACITY

Class	Design <sup>1/</sup> Axle-Load (Metric Tons)	National Roads		Provincial Roads		County Roads		Total System	
		km <sup>2</sup> )	%	km <sup>2</sup> )	%	km <sup>2</sup> )	%	km <sup>2</sup> )	%
I	7.00	70	1	50	about 1/4	-	-	120	about 1/7
II	5.00	1,230	12	1,250	6	-	-	2,480	3
III	3.50	3,200	32	9,000	41	-	-	12,200	15
III-A	2.75	1,900	19	4,000	18	-	-	5,900	7
IV	2.00	2,000	20	7,000	32	-	-	9,000	11
V	1.50	1,600	16	700	3	50,000 <sup>3/</sup>	100	52,300	64
		10,000	100	22,000	100	50,000	100	82,000	100

- <sup>1/</sup> The works organizations' procedures for determining pavement strength are conservative, and the above figures may therefore be pessimistic; the weight and volume of traffic using the system confirms this. (Pavement strength is, in any case, affected by the moisture condition below the pavement and would undoubtedly be improved by simple works designed to eliminate the more serious defects of the surface drainage system, (para. 3.03). The load-carrying capacity of the bridges is generally compatible with that of the road of which they form part, but the weights of vehicles using the bridges indicate that bridge classification, too, may be unduly pessimistic.
- <sup>2/</sup> Lengths<sup>1</sup> rounded to accord with the approximate total length of the system, (para. 3.01).
- <sup>3/</sup> The classification of county roads as 'V' reflects primarily the strength of the bridges only, since 90% county roads are unpaved (Table 3) and pavement strength is not meaningful unless ambient conditions are specified.

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Source: Directorate-General of Highway Construction, Ministry of Public Works and Power.

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INDONESIA - HIGHWAY PROJECT

TABLE 3

THE PUBLIC HIGHWAY SYSTEM

Analysis by Type of Surface

	National Roads		Provincial Roads		County Roads		Total	
	<u>Km 1)</u>	<u>%</u>	<u>Km 1)</u>	<u>%</u>	<u>Km 1)</u>	<u>%</u>	<u>Km 1)</u>	<u>%</u>
Asphalt Concrete	150	1.5	-	-	-	-	150	0.2
Paved (Bituminous Surface Treatment	4,500	45.0	8,000	36.4	3,000	10.0	15,500	18.9
Un- Paved (Gravel	5,350	53.5	12,000	54.5	16,500	31.0	33,850	41.3
(Earth	-	-	2,000	9.1	30,500	59.0	32,500	39.6
	10,000	100.0	22,000	100.0	50,000	100.0	82,000	100.0

1) Lengths rounded to accord with approximate total length of system  
(para. 3.01)

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Source: Directorate-General of Highway Construction;  
Ministry of Public Works and Power

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TABLE 4INDONESIA - HIGHWAY PROJECTVEHICLE FLEET <sup>1/</sup>

	<u>Cars</u>	<u>Buses</u>	<u>Trucks</u>	<u>Total</u>
1961	129,300	17,800	70,000	217,100
1962	124,400	16,800	66,000	207,200
1963	127,800	18,200	69,200	215,200
1964	n.a.	n.a.	n.a.	n.a.
1965	166,800	18,400	84,700	269,900
1966	179,500	19,600	92,900	292,000
1967	185,000	18,800	94,900	298,700

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<sup>1/</sup> Excluding Armed Forces

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Source: Central Bureau of Statistics

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TABLE 5

## INDONESIA - HIGHWAY PROJECT

## VEHICLE FLEET - REGIONAL DISTRIBUTION

1965-1968

	<u>Year</u>	<u>Cars</u>	<u>Buses</u>	<u>Trucks</u>	<u>Total</u>
1. J a v a	1965	129,957	8,606	50,222	188,785
	1966	139,787	9,315	56,478	205,580
	1967	144,107	8,329	57,311	209,747
-----					
2. Sumatra	1965	24,514	7,916	23,328	55,758
	1966	26,632	8,328	25,055	60,015
	1967	27,509	8,297	25,446	61,252
-----					
3. Sulawesi	1965	3,433	718	4,334	8,485
	1966	3,492	820	4,188	8,500
	1967	3,770	947	5,381	10,098
-----					
4. Kalimantan	1965	3,881	311	3,248	7,440
	1966	4,305	265	3,484	8,054
	1967	4,210	322	3,187	7,719
-----					
5. Other Islands	1965	5,060	863	3,522	9,445
	1966	5,278	856	3,686	9,820
	1967	5,358	945	3,567	9,870
=====					
6. Total Indonesia	1965	166,845	18,414	84,654	269,913
	1966	179,494	19,584	92,891	291,969
	1967	184,954	18,840	94,892	298,686

Source: Central Bureau of Statistics

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TABLE 6

INDONESIA - HIGHWAY PROJECT  
ROAD TRANSPORT FUEL CONSUMPTION

	Gasoline (Metric tons)				Dieselfuel (Metric Tons)			
	Java	Sumatra	Other	Total	Java	Sumatra	Other	Total
				'000				'000
1962	n.a.	n.a.	n.a.	1,235	n.a.	n.a.	n.a.	746
1963	n.a.	n.a.	n.a.	1,233	n.a.	n.a.	n.a.	895
1964	n.a.	n.a.	n.a.	872	n.a.	n.a.	n.a.	800
1965	958	182	57	1,198	186	255	36	1,107
1966	925	226	52	1,399	590	238	45	873
1967	1,006	280	50	1,336	422	238	47	707
1968	1,053	315	56	1,423	403	259	42	705

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1/ Including Armed Forces

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Source: Pertamina

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INDONESIA - HIGHWAY PROJECT

Road Rehabilitation Teams and Equipment

1. Each provincial rehabilitation team comprises a number of different sub-teams equipped to carry out: (i) pavement renewal; (ii) pavement resealing; (iii) unpaved road rehabilitation; (iv) stone production; or (v) bridge repair. The specific complement of sub-teams in any provincial rehabilitation team is determined by: (a) the length of roads to be rehabilitated; and (b) the nature of the roads (for example, paved or unpaved).

2. The principal items of equipment for each of the sub-teams are typically as follows: <sup>1/</sup>

Sub-Teams	Truck-Mounted Asphalt Distributor	Trailer-Mounted Asphalt Heater	Mechanical Broom	Compressor (small) and Tool Set	Compressor (large) and Tool Set	Crushing Equipment	Concrete Mixer	Pick Up	Hydraulic Jack	Mechanical Shovel Wheeled	Motor Grader 80 - 112 H.P.	Pulvi-Mixer	Mixing Plant - Gravel Pits	4" Pump	Tandem Roller	Rubber-Tired Roller	Power Saw	Stone Spreader	Chip Spreader	Crawler Tractor (D6)	Dump Truck (5-ton)	Flat-bed Truck	Water Truck (6000 liter)	Lubrication Truck	Repair Truck	Fuel Supply Truck	Tractor Truck	Quarry Truck	Industrial Tractor	Plate Vibrator	Concrete Vibrator	Welding Set	20-ton Winch	Drilling Rig
Pavement Renewal <sup>2/</sup>	1	2	1	1	-	-	3	-	2	3	2	-	-	6	-	-	1	1	1	4	4	4	1	1	1	1	-	2	-	-	-	-	-	
Pavement Resealing <sup>2/</sup>	1	3	1	2	-	-	2	-	1	1	-	-	-	3	1	-	-	1	-	18	-	-	1	1	1	-	-	1	1	-	-	-	-	
Unpaved Road	-	-	-	-	-	-	2	-	1	2	-	1	-	2	2	-	-	-	1	33	1	4	1	1	1	-	-	-	-	-	-	-	-	
Stone Production	-	-	-	-	2	1	-	-	1	-	-	-	-	-	-	-	-	-	1	7	2	-	1	-	-	-	4	-	-	-	-	-	1	
Bridge Repair	-	-	-	8	4	-	8	8	16	-	-	-	-	8	-	-	8	-	-	-	20	-	-	-	-	-	-	-	-	20	4	8	-	

Notes:

1/ These scales of equipment represent the operational requirements of the sub-teams; the equipment to be procured under the project represents these scales of equipment less existing equipment which is, or could economically be made, operational.

2/ These sub-teams will also correct deficiencies in shoulder grade and compaction and in the surface water drainage system, as part of the pavement renewal/resealing operation.

Composition of the rehabilitation teams in the five provinces selected is as follows:

Sub-Team	Province					
	East Java	West Java	South Sumatra	West Sumatra	South Sulawesi	
Pavement Renewal	1	1	1	1	1	
Pavement Resealing	1	1	1	1	-	
Unpaved Road	-	-	1	2	1	
Stone Production	2	2	2	2	2	
Bridge Repair	4	3	1	2	3	
Lengths to be rehabilitated under project (km)	paved	783	883	344	306	40
	unpaved	-	-	83	252	348

The average cost of equipment to be procured for each of the five provincial road rehabilitation teams (that is, net of existing operational equipment in the provinces) is in the order of US\$2.25 million equivalent, c.i.f. Jakarta and including 20% of basic cost for initial supply of spares.

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INDONESIA - HIGHWAY PROJECT

Equipment for Urgent Provincial Road Maintenance

Urgent road maintenance equipment needs vary between provinces depending on the extent of the highway system in the province (Table 1), and on the amount of existing equipment which could be made operational. This Table sets out the allocation for road maintenance equipment under the project, for each of the 20 provinces with significant highway maintenance problems, and indicates the principal items of equipment to be provided under the project.

MAINTENANCE EQUIPMENT ALLOCATION BY PROVINCE

PRINCIPAL ITEMS OF EQUIPMENT TO BE PROVIDED

<u>Region</u>	<u>Province</u>	<u>Allocation under Project for maintenance equipment (US\$ million)</u>	<u>Item</u>	<u>No.</u>
Java	West Java	0.45	Truck-mounted asphalt distributor	7
	Central Java	0.30	Asphalt heating tank (stationary)	67
	Jogjakarta	0.10	Compressor (small) and tool set	33
	East Java	0.10	Concrete Mixer	34
Sumatra			Pick-up	60
	Atjeh	0.36	Compressor (large) and tool set	9
	North Sumatra	0.20	Mechanical Shovel, wheeled	13
	West Sumatra	0.35	Motorgrader, 80 H.P.	28
	Riau	0.24	Pump (4")	35
	Djambi	0.36	Crushing and Screening Plant	2
	South Sumatra	0.30	Chip Spreader	4
	Bengkulu	0.28	Dump Truck	150
	Lampung	0.36	Flat-bed truck	144
Kalimantan (Indonesian Borneo)	West Kalimantan	0.40	Truck with Crane	55
	South Kalimantan	0.40	Concrete vibrator	83
	East Kalimantan	0.40	Welding set	8
Sulawesi (Celebes)			Base Radio	20
	North Sulawesi	0.10	Satellite radio	100
	South Sulawesi	0.30	Generating Set	6
The Principal Small Islands	Bali	0.10		
	West-Nusa Tenggara	0.25		
	East-Nusa Tenggara	<u>0.25</u>		
	TOTAL	5.60		

TABLE 8

TABLE 9

INDONESIA - HIGHWAY PROJECTProvincial Workshop RehabilitationDetails and Cost Estimate

<u>Major items of equipment to be supplied per provincial workshop</u>	<u>Association Financing</u> US\$	<u>Government Contribution</u> Rp. (million)
Lathe and attachments )		
Floor drill press )		
Floor dual grinder )		
Bench-mounted drill press )		
Bench-mounted dual grinder )		
Work benches complete (3 No.) )		
Hand operated hydraulic press )	40,000	
Mobile arc-welder )		
Mobile gas-welder )		
Power shears )		
Power hacksaw )		
Air compressor )		
Fuel injection pressure tester )		
Battery charging equipment )		
Hand tools	3,750	
Stationary oil and greasing equipment	<u>8,000</u>	
<u>Total for one workshop</u>	<u>51,750</u>	
Total for 20 workshops	1,035,000	
Contingency item for additional equipment	165,000	
Repairs to existing buildings		65
Running costs (personnel, materials, overheads) over 4-year period		520
	<hr/>	
	US\$ 1,200,000	

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TABLE 10INDONESIA - HIGHWAY PROJECTTechnical Support - Details and Cost Estimate

<u>Personnel</u> (all for a 2-year period)	<u>Association Financing</u> US\$ (million)	<u>Government Contribution</u> Rp (millions)
(a) 2 No. experts in each of 20 provinces	2.88	
(b) 5 No. quarrying experts	0.40	
(c) 3 No. Engineering Geologists/ Materials Engineers	0.27	
(d) Directing & Coordinating Team (3 experts)	0.32	
(e) Subsistence for (a) through (d) above		207
<u>Support Costs</u>		
(f) Air Travel		
International	0.17	
Internal	0.18	
(g) Miscellaneous requirements (vehicles, shipping costs, portable testing equipment)	0.21	33
Contingency	<u>0.57</u>	<u>21</u>
	5.00	261

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TABLE 11

## INDONESIA - HIGHWAY PROJECT

Operating Cost of a Representative (3.5 ton capacity)  
Truck on a Flat Paved Road\*

	Rupiahs	
	<u>with taxes</u>	<u>net of taxes</u>
<b>1. <u>Basic Data and Assumptions</u></b>		
Cost of Vehicle	2,040,000	1,600,000
Cost of one set of tires	120,000	114,000
Average gross vehicle weight: 6.5-7 metric tons		
Average vehicle life	: 5 years	
Average annual mileage	: 60,000 km	
Average tire life	: 75,000 km	
Average time in use per year:	2,000 hours	
<b>2. <u>Fixed Costs Per Year</u></b>		
Depreciation	102,000	80,000
Interest	216,000	171,400
Insurance	70,000	58,000
Driver and Assistant	280,000	280,000
License; Yearly Taxes	11,600	-
Overheads	<u>195,000</u>	<u>195,000</u>
Total Fixed Costs per Year	874,600	784,400
<u>Fixed Cost per Hour in Use</u>	437	390
Fixed Costs per km	6.06	5.36
<b>3. <u>Running Costs per km</u></b>		
Depreciation	5.10	4.00
Fuel	4.00	4.00
Oil and Lubricants	0.18	0.15
Tires and Tubes	1.60	1.52
Maintenance: Labor	0.69	0.69
Parts	<u>6.70</u>	<u>4.80</u>
Total Running Cost per km	18.27	15.16
<b>4. <u>Total Cost per km at a Vehicle Speed</u></b>		
<u>of 72 km/hr</u>	24.33	20.52

\* For operating costs on other types and conditions of road, see Table 14.

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TABLE 12

INDONESIA - HIGHWAY PROJECT

OPERATING COST OF A REPRESENTATIVE CAR

ON A FLAT PAVED ROAD\*

<u>1. Basic Data and Assumptions</u>	<u>Rupiahs</u>	
	<u>with taxes</u>	<u>net of taxes</u>
Vehicle Cost	1,875,000	750,000
Cost of one set of Tires	28,000	26,500
Average net weight:	1360 kg	
Average vehicle life:	10 years	
Average annual mileage:	15,000 km	
Average tire life	50,000 km	
Average time in use per year:	1,000 hours	
 <u>2. Fixed Costs per year</u>		
Depreciation	93,750	37,500
Interest	190,300	77,650
Insurance	32,400	13,500
License; Yearly Taxes	<u>9,700</u>	<u>---</u>
Total Fixed Costs per year	326,150	128,650
 <u>Fixed Cost per Hour in Use</u>	326	129
<u>Fixed Cost per km</u>	4.03	1.57
 <u>3. Running Cost per km</u>		
Depreciation	6.25	2.50
Fuel	1.60	1.60
Oil and lubricants	0.12	0.10
Tires and Tubes	0.56	0.53
Maintenance: Labor	0.19	0.19
Parts	<u>1.15</u>	<u>0.82</u>
Running Cost per km	9.87	5.74
 <u>4. Total Cost per km at a Vehicle Speed of 80 km/hour</u>	13.90	7.31

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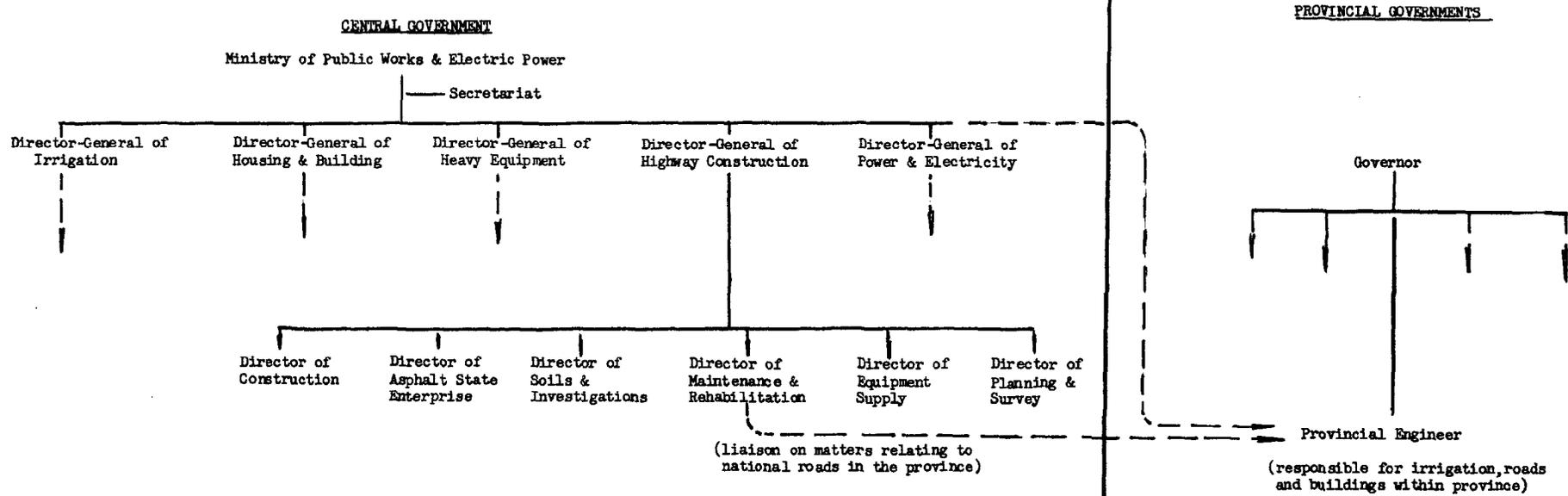
\* For operating costs on other types and conditions of road, see Table 13.

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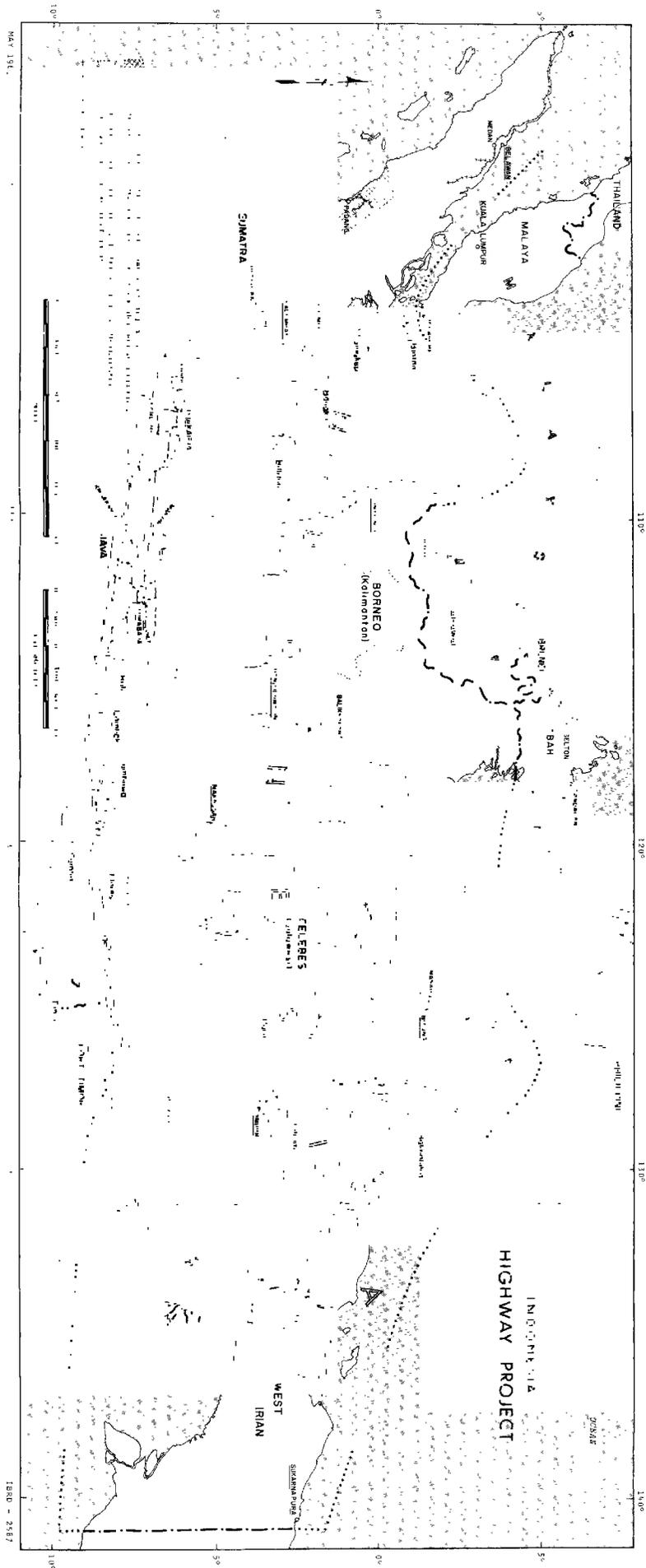


INDONESIA - HIGHWAY PROJECT  
ORGANIZATION OF THE CENTRAL AND PROVINCIAL WORKS ORGANIZATIONS  
IN RELATION TO HIGHWAY ADMINISTRATION



April 29, 1969

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