



GOVERNMENT OF MALAYSIA

HNDP

HIGHWAY NETWORK DEVELOPMENT PLAN STUDY IN MALAYSIA

FINAL REPORT

MAIN VOLUME

MARCH 1993

JAPAN INTERNATIONAL COOPERATION AGENCY

SSF

CR(3)

93-031

Currency equivalents used in this Report are as follows:-

Currency Unit = Ringgit Malaysia (RM)

RM 1.00 = US\$ 0.394

RM 1.00 = J¥ 49.349

(As of December 1992)

JICA LIBRARY



1105392131

25071



GOVERNMENT OF MALAYSIA

HNDP

HIGHWAY NETWORK DEVELOPMENT PLAN STUDY IN MALAYSIA

FINAL REPORT

MAIN VOLUME

MARCH 1993

JAPAN INTERNATIONAL COOPERATION AGENCY

国際協力事業団

25071

Preface

In response to a request from the Government of Malaysia, the Government of Japan decided to conduct a Highway Network Development Plan Study in Malaysia and entrusted the study to the Japan International Cooperation Agency (JICA).

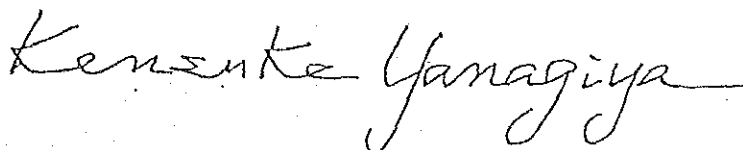
JICA sent to Malaysia a study team headed by Mr. Kokuro Hanawa, Fukuyama Consultants International Co.Ltd., from May 1991 to February 1993.

The team held discussions with the officials concerned of the Government of Malaysia, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Malaysia for their close cooperation extended to the team.

March, 1993

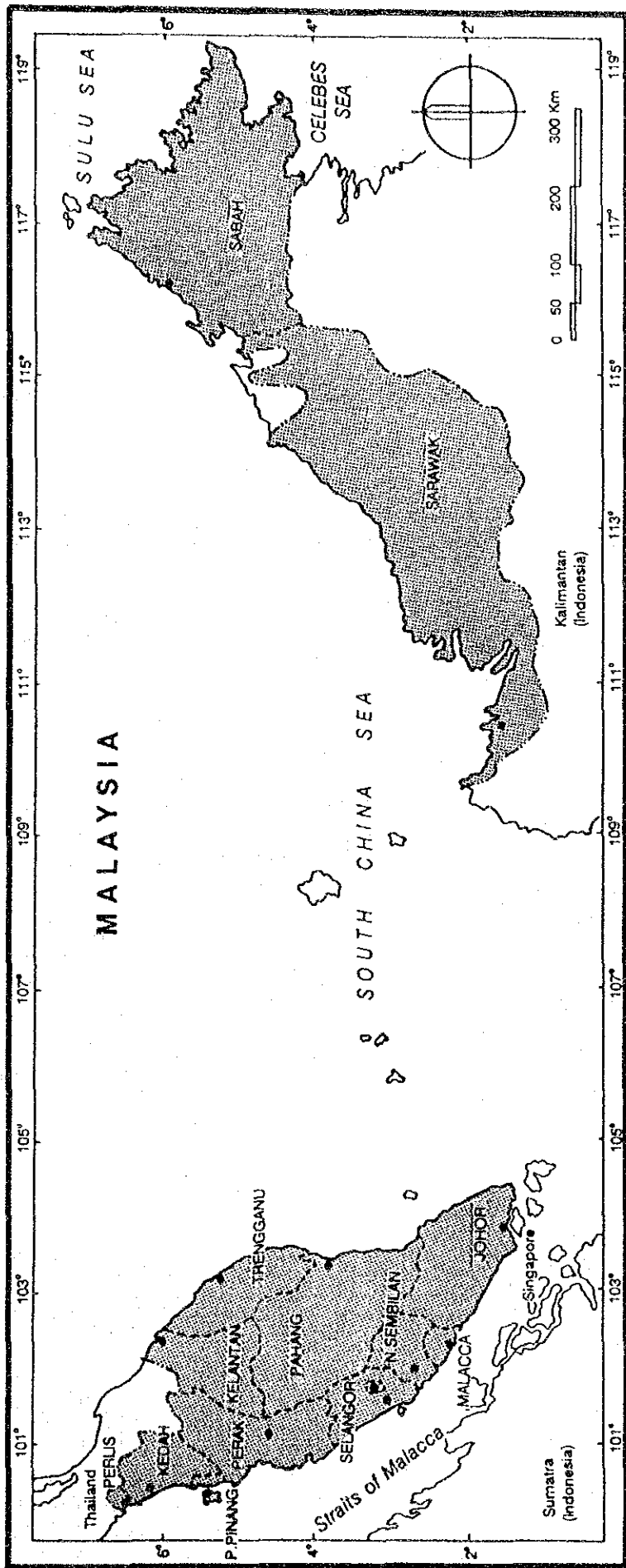


Kensuke Yanagiya

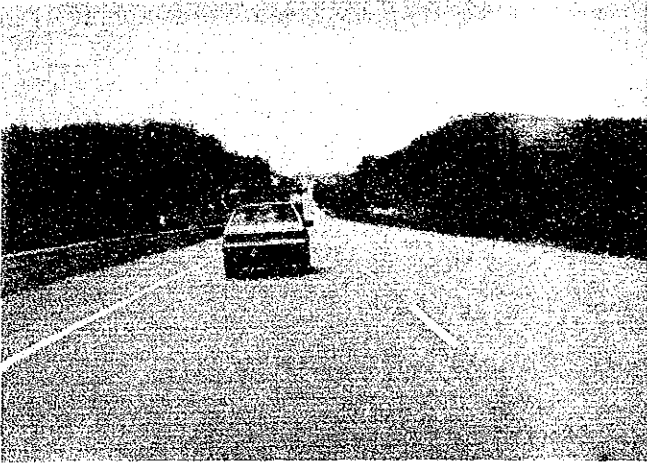
President

Japan International Cooperation Agency

LOCATION MAP

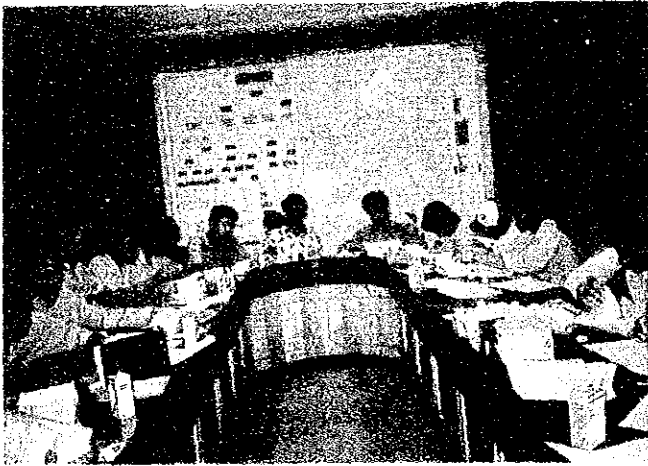


PENINSULAR MALAYSIA



(Top To Bottom, Left To Right)

- * The well maintained North-South Expressway near Pagoh in Johor
- * Federal Route 1 directly cut through the town of Kampar in Perak. urban bypasses for such areas are needed to promote better level of services on the inter-urban highway.
- * The national inter-urban highway network also pass by environmental areas such as the Rompin National Park in Johor.
- * The rail transport in the country requires urgent improvements and modernization measures to upgrade its services so that it can become a more important alternative inter-urban transport mode.
- * The Federal Route 4 passes through some steep terrain across the Main Range from Kedah to Kelantan.
- * Sections of the federal road at the fringe of major urban centers often encounter traffic congestion.
- * High traffic accident fatality rate in the country is now a major concern of the authority.

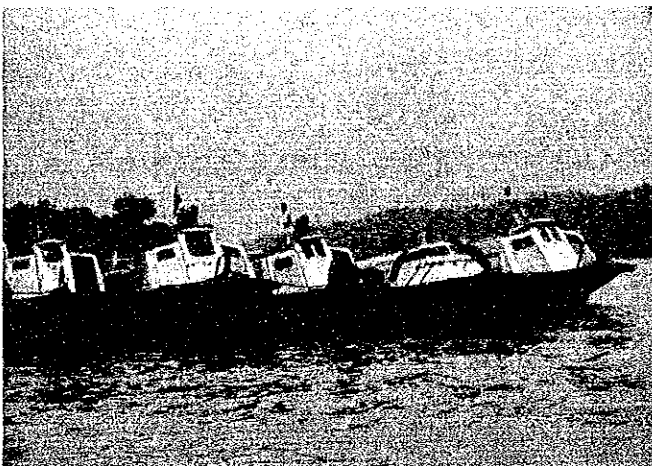
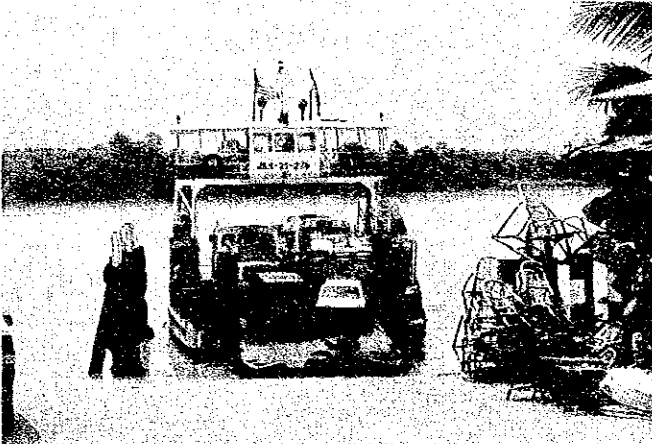
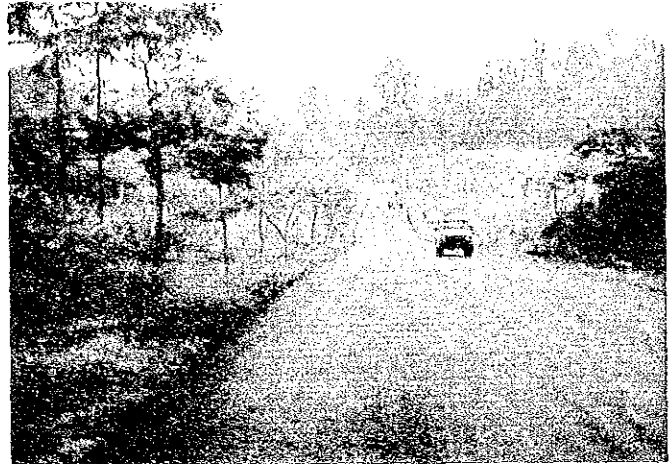
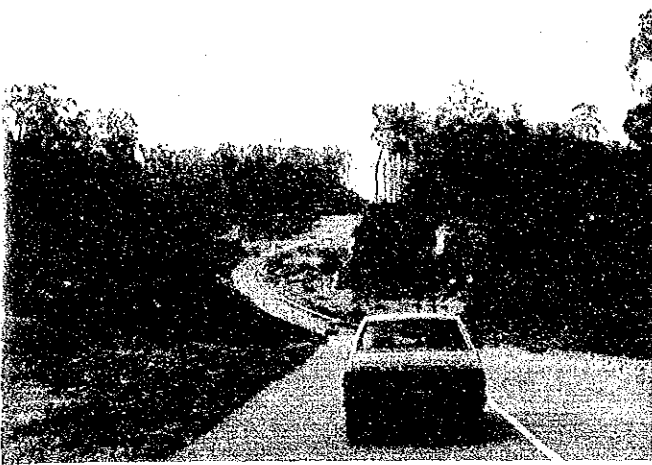


(Top To Bottom, Left To Right)

- * Sampling work for the Owner Interview Survey in progress at the state JPJ office.
- * One of the 14 survey operation centers set up at state JKR office throughout Peninsular Malaysia for monitoring the progress of the traffic surveys.
- * Road side interview survey in progress along the North-south Expressway near Simpang Empat, Malacca
- * Large truck carrying timber logs and other agricultural produce are being interviewed on the Federal Route 4 (East-West Highway)
- * Road side interview survey at State boundary of Kelantan and Trengganu.
- * Besides road side counting and interview survey, a simple survey on river transport was also carried out in Sarawak.



SABAH & SARAWAK



(Top To Bottom, Left To Right)

- * This trunk road passes through some natural forest in Sarawak. Highway development that may produce adverse impacts on the natural environment requires more indepth environmental impact assessment (EIA) studies.
- * River transport is an important mode of travel in Sarawak. Ferry services provide important linkage across a tributary of the Rajang River
- * High speed boats lined up a jetty near Sibn. These boats provide an important means of transport to towns such as Kapit in the interior.
- * This section of the trunk road in Sarawak has just being paved. The proportion of all season roads is still low in Sarawak and Sabah compared to Peninsular.
- * This section of the trunk road is undergoing pavement work. Most of the trunk road should be paved to ensure reliability in road transport.
- * Conditions of trunk roads in Sabah is very similar to those in Sarawak. This is the standard 2 lane highway near Sandakan.
- * Sections of the trunk roads near Kota Kinabalu are well developed and maintained with wide dual carriageways.



CONTENTS

	PAGE
PREFACE	
EXECUTIVE SUMMARY	
CHAPTER 1 : INTRODUCTION	
1.1 Background To The Study	1-1
1.2 Objectives of Study	1-1
1.3 Study Area	1-1
1.4 Study Approach and Scope of Work	1-1
1.5 Organization of The Study	1-5
CHAPTER 2 : EXISTING TRANSPORT AND ROAD TRAFFIC SITUATIONS	
2.1 Traffic Surveys	2-1
2.2 Existing Transport System	2-2
2.3 Transport Demand in Peninsular Malaysia	2-4
2.4 Road Traffic Characteristics in Peninsular Malaysia	2-4
2.4.1 Road Traffic Demand	2-4
2.4.2 Road Traffic Characteristics	2-6
2.5 Road Traffic Characteristics in Sabah and Sarawak	2-11
CHAPTER 3 : EXISTING HIGHWAY NETWORK CONDITIONS	
3.1 Existing Highway Network Configuration in Malaysia	3-1
3.2 Natural Conditions	3-4
3.3 Road Administration	3-5
3.4 Physical Conditions of the Existing Highway Network	3-6
3.5 Examination of the Accessibility on Existing Highway Network	3-12
3.6 Traffic Volume and Capacity Analysis on the Existing Highway Network	3-17
3.7 Road Development Level in Malaysia	3-19
3.8 Road Traffic Safety	3-23
3.9 Problems Facing Existing Road Transport in Malaysia	3-23
CHAPTER 4 : SOCIO ECONOMIC FRAMEWORK STUDY	
4.1 Introduction	4-1
4.2 National Socio-Economic Framework to the Year 2010	4-1
4.3 Regional Socio-Economic Framework to the Year 2010	4-4

4.4	Socio-Economic Indicators at District Level	4-7
4.5	Forecasting of Number of Vehicles	4-8
CHAPTER 5 : TRAFFIC DEMAND FORECASTING		
5.1	Introduction	5-1
5.2	Macro Level Traffic Demand Forecasting for Peninsular Malaysia to Year 2010 Under "Do-Nothing" Scenario	5-2
5.2.1	Multi Modal Trip Production Rates	5-2
5.2.2	Vehicle Trip Generation and Attraction	5-5
5.2.3	Vehicle OD Distribution	5-6
5.3	Macro Level Traffic Demand Forecasting for Peninsular Malaysia to Year 2010 Under The "Do-Something" Scenario	5-9
5.3.1	Share of Transport Modes	5-9
5.3.2	Vehicle Trip Distribution Under The "Do- Something" Scenario	5-12
5.4	Micro Level Traffic Demand Forecasting in Peninsular Malaysia	5-16
5.4.1	Micro Level Trip Generation and Attraction Forecasting	5-17
5.4.2	Trip Assignment	5-17
5.5	Traffic Demand Forecasting in Sabah and Sarawak	5-18
5.5.1	Existing Vehicle Traffic Demand in Sabah	5-19
5.5.2	Existing Vehicle Traffic Demand in Sarawak	5-21
5.5.3	Vehicle Traffic Demand Forecasting for Sabah and Sarawak to Year 2010	5-23
CHAPTER 6 : HIGHWAY NETWORK DEVELOPMENT PLANNING		
6.1	Introduction	6-1
6.2	Planning Goals and Objectives	6-3
6.3	Highway Network Planning Approach	6-5
6.4	Existing and Foreseeable Road Transport Problems and Issue	6-5
6.5	Highway Network Planning Constraints and Considerations	6-6
6.6	Highway Network Development Strategies	6-15
6.6.1	Highway Development Strategies at the National Level	6-15
6.6.2	Highway Development Strategies at Regional Level	6-18
6.7	National and Regional Highway Network Concept Plans	6-18
6.7.1	Functional Highway Network Classification	6-18
6.7.2	Proposed National Highway Network Configuration	6-20
6.7.3	Regional Highway Network Configuration	6-24
6.7.4	Proposed Highway Network Concept Plans	6-30
6.8	Alternative Future Highway Network Development Plans	6-30

CHAPTER 7 : PRELIMINARY ENGINEERING STUDY AND COST ESTIMATION		
7.1	General	7-1
7.2	Design Criteria and Its Application	7-1
7.3	Geology and Topography Conditions	7-5
7.4	Unit Cost Analyses	7-7
7.5	Summary of Alternative Network Plans	7-9
7.6	Estimation of Construction Cost	7-9
CHAPTER 8 : EVALUATION OF ALTERNATIVE PLANS		
8.1	Evaluation Procedure	8-1
8.2	Functional Suitability	8-2
	8.2.1 Network Plan for Peninsular	8-2
	8.2.2 Network Plan for Sabah and Sarawak	8-3
8.3	Economic Evaluation	8-5
	8.3.1 Economic Cost	8-6
	8.3.2 Economic Benefit	8-6
8.4	Social and Regional Development Consideration	8-16
8.5	Recommended Road Network	8-18
CHAPTER 9 : IMPLEMENTATION PLAN		
9.1	Examination of Development Funds	9-1
9.2	Identification of Highway Projects	9-5
9.3	Priority of the Project Roads	9-8
9.4	Implementation Program	9-11
CHAPTER 10 : CONCLUSIONS AND RECOMMENDATIONS		
10.1	Proposed Highway Network Development Plan	10-1
	10.1.1 Highway Network Development Plan in Peninsular Malaysia	10-1
	10.1.2 Highway Network Development Plan in Sabah and Sarawak	10-4
10.2	Investment Requirements	10-6
10.3	Implementation Programme	10-6
10.4	Policies and Strategies for Highway Network Development Plan	10-7
	10.4.1 Policies	10-7
	10.4.2 Highway Network Configuration	10-8
	10.4.3 Road Traffic Safety	10-8
	10.4.4 Environmental Issues	10-9
	10.4.5 Inland Transport Facilities	10-10
	10.4.6 Modernization of Freight Transport System	10-10
	10.4.7 Toll Road System and Privatization	10-11
	10.4.8 Further Studies and Review	10-12

LIST OF TABLES

PAGE

CHAPTER 2

Table 2.1	Summary of All Traffic Surveys Carried Out	2-2
Table 2.2	Summary of Transport Infrastructure in Malaysia in 1990	2-3
Table 2.3	Estimated Transport Demand by Modes in Peninsular Malaysia, 1991	2-4
Table 2.4	Total Daily Traffic Demand in Peninsular Malaysia, 1991	2-5
Table 2.5	Trip Production Rate by Vehicle Type in Peninsular Malaysia in 1991	2-7
Table 2.6	Trip Production Rate by Vehicle Type in Sabah and Sarawak in 1991	2-11

CHAPTER 3

Table 3.1	Road Length in Malaysia, 1990	3-1
Table 3.2	Study Road Length by Classification	3-4
Table 3.3	Road Classification According to Administration	3-5
Table 3.4	Inventory on Number of Lane for Federal Trunk Roads	3-6
Table 3.5	Share of Paved and Unpaved Roads in Malaysia	3-7
Table 3.6	Type of Pavement of Federal Trunk Roads in Malaysia	3-7
Table 3.7	Length of Federal Trunk Roads Found with Deficient Carriageway Width	3-8
Table 3.8	Access Time to Expressway Interchange	3-15
Table 3.9	Road Development Level Indicators	3-18
Table 3.10	International Road Development and Service Levels	3-19
Table 3.11	Road Development and Service Levels by Regions	3-20

CHAPTER 4

Table 4.1	Macro Socio-Economic Indicators, 1980 - 2010	4-2
Table 4.2	Gross Domestic Products by Industry of Origin, 1985-2010	4-3
Table 4.3	Population by State, 1980 - 2010	4-4
Table 4.4	Gross Domestic Product by State, 1980-2010	4-5
Table 4.5	Labour Force by State, 1990 - 2010	4-6
Table 4.6	Employment by State, 1990 - 2010	4-7
Table 4.7	Vehicle Ownership Forecasting Models, Malaysia	4-7
Table 4.8	Number of Vehicles in Malaysia, 2010	4-9
Table 4.9	Number of Vehicle Forecasting Models, by State	4-9
Table 4.10	Forecasted Future Vehicle Number, 2010	4-10

CHAPTER 5

Table 5.1	Future Trip Production Rates by Vehicle Type	5-4
Table 5.2	Trip Generation and Attraction Models, Peninsular Malaysia	5-5

Table 5.3	Traffic Demand by Transport Mode in Peninsular Malaysia, in 1991 and 2010	5-10
Table 5.4	Trip Generation and Attraction Model at Traffic Zone Level	5-17
Table 5.5	Future Vehicle Trip Production by Vehicle Type for Sabah, 2010	5-24
Table 5.6	Future Vehicle Trip Production by Vehicle Type for Sarawak, 2010	5-24

CHAPTER 7

Table 7.1	Functional Classification and Design Standard	7-3
Table 7.2	Standard of Interchange's Intervals	7-3
Table 7.3	Interchanges and At-Grade Intersections Design Criteria	7-4
Table 7.4	Service Facilities Interval	7-4
Table 7.5	Designed Roads and Highways Capacity	7-5
Table 7.6	Terrain Conditions and Natural Ground Cross Slopes	7-6
Table 7.7	Summary of Construction Unit Price (1992)	7-7
Table 7.8	Summary of Unit Cost Calculations For Peninsular (1992)	7-8
Table 7.9	Summary of Length of Preliminary Design of Highway Network Plans	7-11
Table 7.10	Summary of Preliminary Design Estimated Project Cost by Alternatives and Region	7-12

CHAPTER 8

Table 8.1	Level of Services by Alternative Network for Peninsular Malaysia, 1991 and 2010	8-2
Table 8.2	Level of Services for Sabah and Sarawak, 1991 and 2010	8-4
Table 8.3	Total Economic Costs of Alternative Network Plan	8-6
Table 8.4	Vehicle Price and Characteristics	8-7
Table 8.5	Fuel and Lubricant Oil Cost	8-8
Table 8.6	Tyre Cost	8-8
Table 8.7	Parts Cost and Maintenance Labour Cost	8-9
Table 8.8	Vehicle Life and Salvage Value	8-9
Table 8.9	Unit Running Cost	8-10
Table 8.10	Crew Wage and Overhead/Insurance Cost (RM)	8-11
Table 8.11	Unit Fixed Cost	8-12
Table 8.12	Unit Travel Time Cost	8-13
Table 8.13	River Transport Cost in Sarawak	8-14
Table 8.14	Economic Benefit of Alternative Network Plans in Peninsular Malaysia	8-14
Table 8.15	Economic Benefit of Proposed Network Plans in Sabah and Sarawak	8-15

Table 8.16	Evaluation Indicators of Alternative Network Plans for Peninsular Malaysia	8-15
Table 8.17	Evaluation Indicators for Sabah and Sarawak	8-16
Table 8.18	Road Development Index for Inter-Urban Highway Network by Areas and Alternative Plans	8-17
Table 8.19	National Road Development Index for Highway in Foreign Countries	8-18
CHAPTER 9		
Table 9.1	Past Development Expenditure of Federal Government	9-1
Table 9.2	Estimation of Total Development Funds of Federal Government	9-2
Table 9.3	Estimation of Development Allocation to Highways	9-3
Table 9.4	Major Committed Projects to be Continued to 7MP	9-4
Table 9.5	Development Funds of Public Sector	9-4
Table 9.6	Candidate Projects for Privatization	9-5
Table 9.7	Target Shares for the Projects	9-11
Table 9.8	Proposed Implementation Schedule of Highway Projects	9-17
CHAPTER 10		
Table 10.1	Summary of Proposed Highway Network for P. Malaysia to 2010	10-1
Table 10.2	Summary of Proposed Highway Network in Sabah and Sarawak to 2010	10-4
Table 10.3	Investment Requirements by Road Function to 2010	10-6
Table 10.4	Investment Requirements by Project Type to 2010	10-6
Table 10.5	Implementation Programme for Future Highway Development to 2010	10-7

LIST OF FIGURES

PAGE

CHAPTER 1

- | | | |
|------------|---|-----|
| Figure 1.1 | Study Area For HNBP Study | 1-2 |
| Figure 1.2 | Flowchart of Study Approach and Phasing | 1-4 |
| Figure 1.3 | Organization Set Up For This Study | 1-5 |

CHAPTER 2

- | | | |
|-------------|---|------|
| Figure 2.1 | Percentage Share of Daily Total Vehicle Trips by Vehicle Type in Peninsular Malaysia | 2-5 |
| Figure 2.2 | Percentage Share of Daily Total Passenger Car Trip by Trip Purpose in Peninsular Malaysia | 2-5 |
| Figure 2.3 | Daily Total Freight Traffic by Commodity Type in Peninsular Malaysia | 2-6 |
| Figure 2.4 | Daily Total Vehicle Trip Generation and Attraction by Vehicle Type and State in Peninsular Malaysia, 1991 | 2-8 |
| Figure 2.5 | Vehicle Trip OD Pattern in Peninsular Malaysia in 1991 | 2-9 |
| Figure 2.6 | Trip Length Distribution by Vehicle Type in Peninsular Malaysia | 2-10 |
| Figure 2.7 | Trip Generation and Attraction in Sabah, 1991 | 2-12 |
| Figure 2.8 | Trip Generation and Attraction in Sarawak, 1991 | 2-12 |
| Figure 2.9 | Vehicle Trip OD Pattern in Sabah in 1991 | 2-13 |
| Figure 2.10 | Vehicle Trip OD Pattern in Sarawak in 1991 | 2-13 |

CHAPTER 3

- | | | |
|-------------|---|------|
| Figure 3.1 | Existing Highway Network in Peninsular Malaysia | 3-2 |
| Figure 3.2 | Existing Highway Network in Sabah and Sarawak | 3-3 |
| Figure 3.3 | Highway Section with Deficient Carriageway Width in Peninsular Malaysia | 3-9 |
| Figure 3.4 | Highway Section with Deficient Carriageway Width in Sabah and Sarawak | 3-10 |
| Figure 3.5 | Highway Sections With Deficient Horizontal Alignment in Peninsular Malaysia | 3-11 |
| Figure 3.6 | Route Reliability Analysis on Highway in P. Malaysia | 3-13 |
| Figure 3.7 | Detour Rate Between Major Centres | 3-14 |
| Figure 3.8 | Areas Within 20km Radius and More Than 20km Radius From Interchanges on the Expressway Corridor | 3-16 |
| Figure 3.9 | Traffic Congestion Sections on Existing Highway Network in Peninsular Malaysia | 3-17 |
| Figure 3.10 | Comparative Analyses of Road Development Levels by Region in Malaysia | 3-21 |

CHAPTER 4

Figure 4.1	Approach in Estimating and Forecasting Future Socio-Economic Indicators	4-1
------------	---	-----

CHAPTER 5

Figure 5.1	Approach for Forecasting Future Traffic Demand	5-1
Figure 5.2	Process of Determination of Trip Production in Peninsular Malaysia	5-3
Figure 5.3	Procedure for Forecasting Vehicle Trip Generation and Attraction in Peninsular Malaysia to Year 2010	5-5
Figure 5.4	Trip Generation and Attraction for Peninsular Malaysia to Year 2010 under "Do-Nothing" Scenario	5-7
Figure 5.5	Vehicle Trip Distribution Pattern for Peninsular Malaysia to Year 2010 under "Do-Nothing" Scenario	5-8
Figure 5.6	Future Rail Passenger Traffic Demand in Peninsular Malaysia in 2010	5-11
Figure 5.7	Future Rail Freight Traffic Demand in Peninsular Malaysia in 2010	5-11
Figure 5.8	Future Vehicle Trip Distribution Pattern in Peninsular Malaysia, 2010 under the "Do-Something" Scenario	5-13
Figure 5.9	Comparison of Corridor Vehicle Traffic Demand in Peninsular Malaysia under "Do-Nothing" and "Do-Something" Scenario in 2010	5-16
Figure 5.10	Process of Micro-Level Traffic Demand Forecasting	5-16
Figure 5.11	Procedure of Equilibrium Traffic Assignment	5-18
Figure 5.12	Procedure for Estimating Vehicle Traffic Demand in Sabah in 1991	5-20
Figure 5.13	Procedure for Estimating Vehicle Traffic Demand in Sarawak, 1991	5-22
Figure 5.14	Procedure for Future Traffic Demand Forecasting in Sabah and Sarawak	5-23
Figure 5.15	Vehicle Trip Generation and Attraction, Sabah and Sarawak, 2010	5-25
Figure 5.16	Vehicle Trip Distribution Pattern in Sabah and Sarawak, 2010	5-26

CHAPTER 6

Figure 6.1	General Approach in Developing Alternative Highway Network Plans	6-2
Figure 6.2	Urban Hierarchy in Peninsular Malaysia	6-7
Figure 6.3	Urban Hierarchy in Sabah and Sarawak	6-8
Figure 6.4	Industrial Development PGA in Peninsular Malaysia	6-10

Figure 6.5	Industrial Development PGA in Sabah and Sarawak	6-11
Figure 6.6	Natural Conservation Areas in Peninsular Malaysia	6-13
Figure 6.7	Natural Conservation Areas in Sabah and Sarawak	6-14
Figure 6.8	Highway Development Strategies in Peninsular Malaysia	6-16
Figure 6.9	Highway Development Strategies in Sabah and Sarawak	6-17
Figure 6.10	The Functional Highway Network Concept and Classification	6-20
Figure 6.11	Highway Network Configuration in Peninsular Malaysia	6-22
Figure 6.12	Highway Network Configuration in Sabah and Sarawak	6-23
Figure 6.13	Conceptual Regional Highway Configuration for North Region in Peninsular Malaysia	6-25
Figure 6.14	Conceptual Regional Highway Configuration for South Region in Peninsular Malaysia	6-26
Figure 6.15	Conceptual Regional Highway Configuration for Central Region in Peninsular Malaysia	6-27
Figure 6.16	Conceptual Regional Highway Configuration for East Region in Peninsular Malaysia	6-29
Figure 6.17	Conceptual Future Highway Network In Peninsular (By Functional Classification)	6-32
Figure 6.18	Conceptual Future Highway Network In Sabah and Sarawak (By Functional Classification)	6-33
Figure 6.19	Future Highway Network Alternative 1	6-34
Figure 6.20	Future Highway Network Alternative 2	6-35
Figure 6.21	Future Highway Network Alternative 3	6-36
Figure 6.22	Future Highway Network Development Plan for Sabah and Sarawak	6-37

CHAPTER 8

Figure 8.1	Evaluation Procedure	8-1
Figure 8.2	Cost and Benefit	8-5

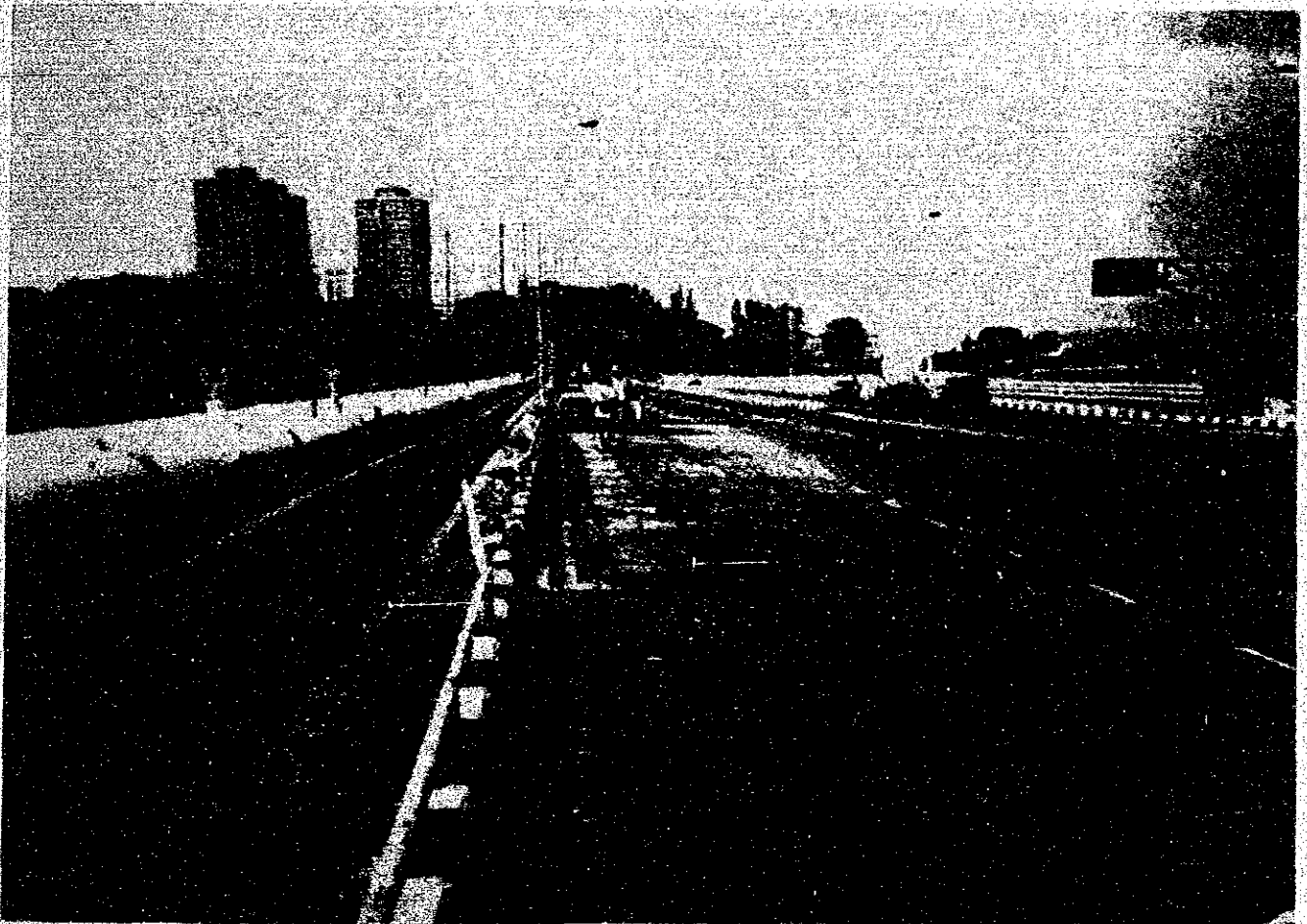
CHAPTER 9

Figure 9.1	Location of Project Roads in Peninsular Malaysia	9-6
Figure 9.2	Location of Project Roads in Sabah and Sarawak	9-7
Figure 9.3	Identification Procedure for Project Priority	9-8
Figure 9.4	First Priority Projects in Peninsular Malaysia	9-12
Figure 9.5	First Priority Projects in Sabah and Sarawak	9-13
Figure 9.6	Second Priority Projects in Peninsular Malaysia	9-14
Figure 9.7	Second Priority Projects in Sabah and Sarawak	9-15

CHAPTER 10

Figure 10.1	Proposed Highway Network in Peninsular Malaysia to 2010	10-2
Figure 10.2	Proposed Highway Network Plan in Sabah and Sarawak to 2010	10-5

EXECUTIVE SUMMARY



Johor - Singapore Causeway

EXECUTIVE SUMMARY

A. Outline of The Study

In response to the request by the Government of Malaysia for technical cooperation in conducting a Highway Network Development Plan Study in Malaysia (hereinafter referred to as HNDP Study), the Government of Japan, through the Japan International Cooperation Agency (JICA), dispatched a Study Team to carry out this Study jointly with the Government of Malaysia. The study in Malaysia started in May 1991 and completed in February 1993.

There are two main objectives to be achieved. These are:

- (1) To formulate a development plan of the national highway network up to the year 2010,
- (2) To prioritize new and improved linkages in the planned network with respect to technical and economic considerations and to formulate a road development program.

The Study covers the 13 states of Malaysia and the Federal Territories. Due to geographical, social and developmental differences between Peninsular Malaysia with Sabah and Sarawak, different traffic surveys were designed to suit the different conditions. Analyses and traffic demand forecasting for example, were carried out separately for P.Malaysia and Sabah and Sarawak.

This Study focuses primarily on the inter-urban road network excluding intra-urban facilities such as bypasses and ring roads that do not affect inter-urban traffic. The total study road length was 16,291 km.

The study team carried out extensive data collection from existing data sources as well as traffic surveys. A total of seven different types of traffic surveys were conducted throughout the study area. About 50,000 vehicle owners were interviewed on their trip patterns while traffic counting and roadside interviews were carried out at 73 locations on the existing highway network in Malaysia. Hearings with various state planning authorities and site observation surveys were also carried out.

Based on analyses of these collected data, the study team prepared the existing OD matrices and an updated road inventory, calibrated various traffic demand models and identified the existing road transport problems in the study area. Road development index (RDI) was used as an indicator of road development in Malaysia with other developed countries and between Peninsular Malaysia, Sabah and Sarawak.

Using macro socio-economic indicators provided by the Economic Planning Unit of the Malaysian Government, the study team forecasted the necessary future socio-economic indicators by traffic zones. Applying these results and the calibrated traffic demand models, future vehicle traffic demand for the study area was forecasted to the year 2010. In estimating the future vehicle traffic demand, the study team examined the role of road transport in relation to other modes of travel in Malaysia, particularly rail transport.

A set of broad goals and specific objectives on highway development in Malaysia was proposed by the study. These goals and objectives were aimed at solving the existing road transport problems such as traffic congestion and high traffic number of accidents and for promoting an efficient highway system. They are formulated to be in line with the overall national development policies of the Government of Malaysia as given in the Vision 2020 and Outline Perspective Plan.

In deriving a highway network concept plan for the study area, the study team analyzed and examined in detail various highway planning constraints and considerations. These include the physical and topographic features of the study area, climatic influences, urban development hierarchy system in Malaysia, industrial development plans and programs, tourist development projects, transport facilities planning, regional land development schemes and environmental conservation areas. While road linkages are important and should be provided to the various development schemes or projects, difficult topographic and environmental conservation areas were avoided as much as possible.

For Peninsular Malaysia, the future highway network concept plan stresses on strengthening the highway network for the economically important west coast region, improving east-west linkages, extending the expressway network to the east coast and developing a highway to promote development in the central corridor. For Sabah and Sarawak, the future network concept plan stresses on expanding the existing highway network to the coastal and interior areas, providing a direct linkage between the two states and strengthening the east-west linkages in Sabah.

Three alternative highway network development plans for Peninsular Malaysia were formulated based on the concept plan. Due to the low development level in Sabah and Sarawak, only one alternative highway network plan is proposed.

These alternative plans are evaluated on their functional suitability of the networks, their economic feasibilities and lastly their impacts on promoting social and regional development in the country.

Cost estimates for the alternative plans were carried out by the study team based on detail studies on unit construction cost of various highway structural types in Malaysia and preliminary engineering design of highway cross-sections. Although there are many direct and indirect benefits that can be derived from road development, the two main quantifiable benefits namely savings in vehicle operating costs and travel time are estimated for each of the alternative plans.

For evaluating the functional suitability of the alternative network plans, indicators such as future average volume/capacity ratio, average travel speed and average trip length were used. For economic evaluation, three economic indicators namely the benefit-cost ratio (BCR), internal rate of return (IRR) and net present value (NPV) were used. Road development index is utilized as an indicator for assessing the impact of the alternative plans on social and regional development.

Results of the above evaluation and analyses showed that Alternative 2 was the best performing plan and therefore it is recommended to be the future highway network

development plan to the year 2010 in Peninsular Malaysia. The future network plan proposed for Sabah and Sarawak was also found to be functionally and economically feasible. It is therefore proposed to be the future highway development plan for these two states.

The study team analyzed the past investment trend in road development by the Malaysian Government from the Second Malaysia Plan to the Sixth Plan from 1971 to 1995. Analyses were also carried out to rank the proposed highway projects based on their network formation, cost effectiveness, future traffic volume and v/c ratios. These projects were ranked from 1 to 3 according to their level of priority. Projects that can be implemented under the privatization scheme were also identified. Based on these analyses, an implementation plan was proposed with three implementation phases. Projects with relatively higher priority were therefore proposed to be implemented in the first phase of the implementation plan. Lastly, the study team also proposed a set of implementation policies and put forward various other recommendations.

B. Conclusions

(1) Overall Highway Network Development

Results of technical and economic studies showed that the proposed Highway Network Development Plan to the year 2010 with a total road length of 15,298 kilometres is economically and socio-environmentally feasible. When fully implemented, this plan is expected to support and promote the national and regional development plans formulated in the "Vision 2020" and 'NDP' by providing an efficient and reliable road transport infrastructure necessary to meet the future demand for greater mobility and transportation of people and goods throughout the country.

(2) Future Highway Network Configuration

The proposed future highway network for Malaysia will provide accessibility to all regions while strengthening further the existing growth corridors. In Peninsular Malaysia, the Principal Highway Network System comprising of expressways and major highways, is planned along 3 north-south corridors (east, west and central) and 5 east-west corridors. For Sabah and Sarawak, this highway network system is being planned along the entire coastal corridor along Sarawak and continue to Sabah via a new link between Marudi and Lawas. The proposed highway network development plan is shown in Figures 1 and 2.

The Principal Highway Network System thus is the main frame that connects the national capital with national level regional centres and regional capitals, the principal growth areas of industrial development and other strategic growth areas.

This Principal Highway Network System is supplemented and supported by minor highways and primary roads. These roads thus connect regional capitals with regional centres and sub-centres with the main role of providing good accessibility to growth and industrial development areas within the region.

Table 1 : Proposed Highway Network in Malaysia to 2010

(In kilometre)

		Peninsular Malaysia	Sabah	Sarawak	Malaysia
Principal Highway	Expressways	1,394	-	-	1,394
	Major Highways	4,114	892	972	5,978
Sub Total for Principal Highway		5,508	892	972	7,372
Minor Highways		1,826	-	35	1,861
Primary Roads		3,516	1,113	1,436	6,065
Total		10,850	2,005	2,443	15,298

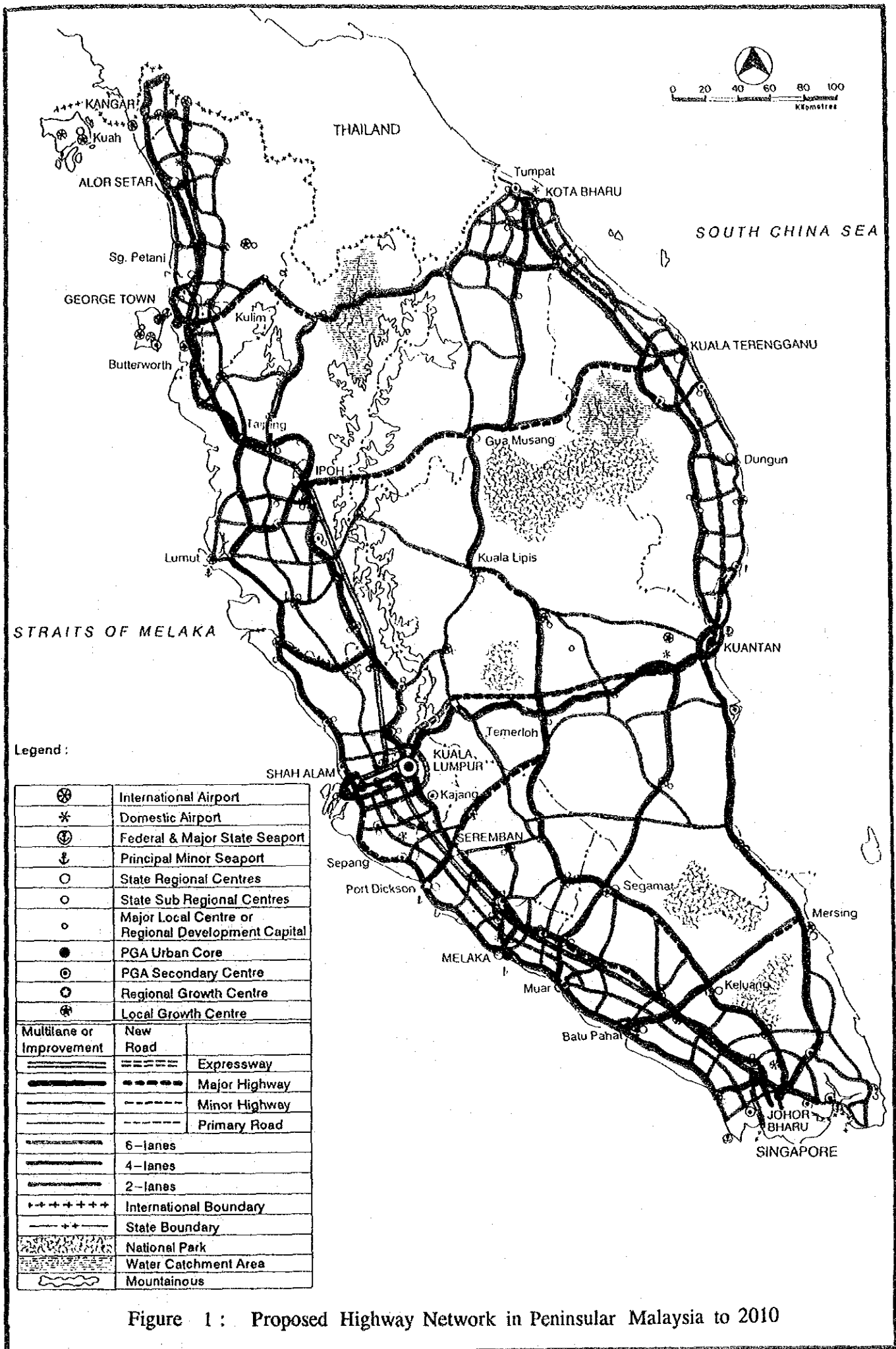


Figure 1 : Proposed Highway Network in Peninsular Malaysia to 2010

Legend :

	International Airport
	Domestic Airport
	Federal & Major State Seaport
	Principal Minor Seaport
	State Regional Centres
	State Sub Regional Centres
	Major Local Centre or Regional Development Capital
	PGA Urban Core
	PGA Secondary Centre
	Regional Growth Centre
	Local Growth Centre
	New Road
	Road Improvement
	Major Highway
	Minor Highway
	Primary Road
	4-lanes
	2-lanes
	International
	State Boundary
	National Park
	Mountainous

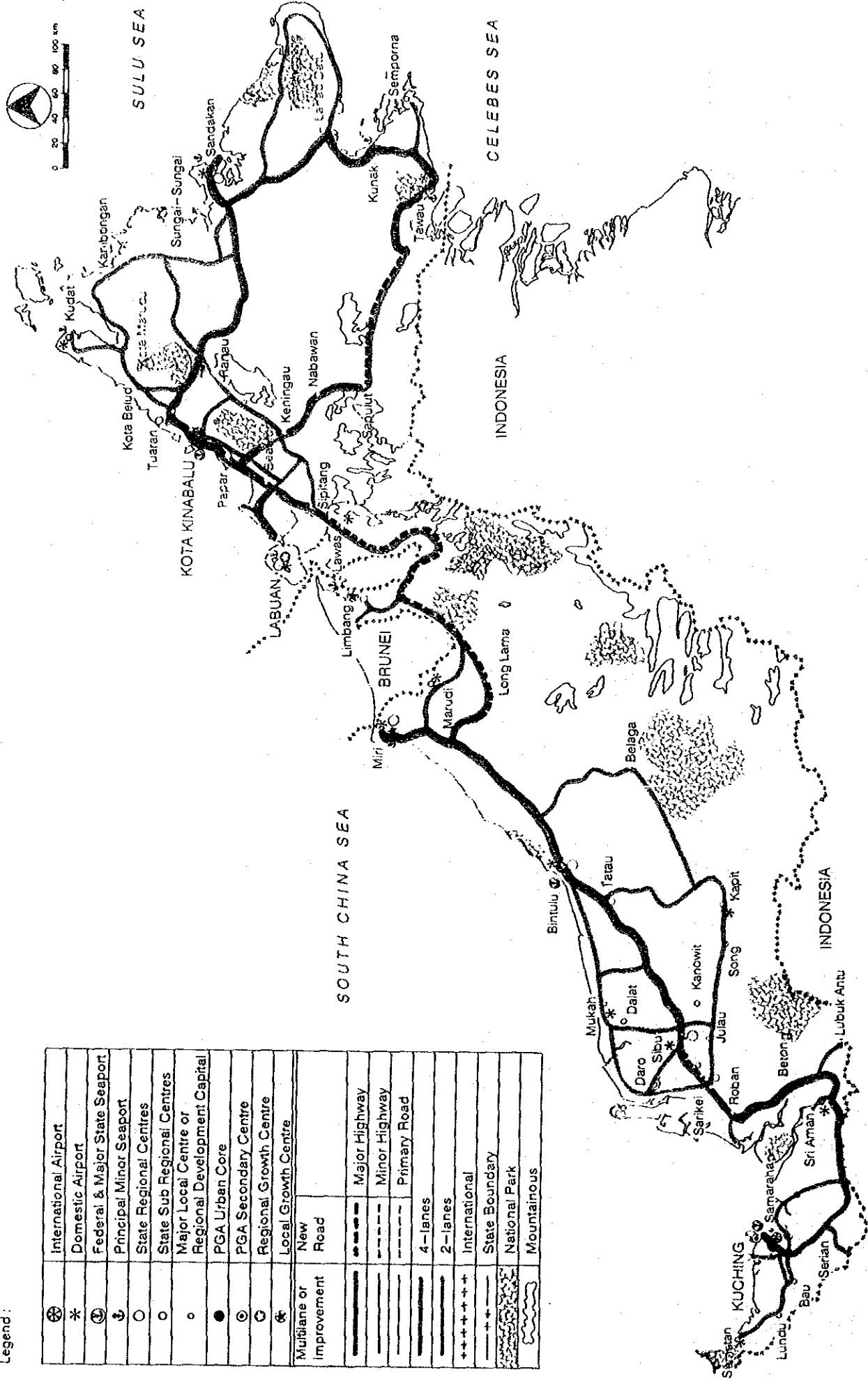


Figure 2 : Proposed Highway Network Plan in Sabah and Sarawak to 2010

(3) Investment Requirements

The total investments required for realizing the proposed future highway network described above by the year 2010 are estimated to be approximately RM 53.0 billion.

Even if some of the proposed projects are assumed to be implemented by privatization scheme, the investment requirements may not be sufficiently met by the highway and bridge allocations in the federal government's development fund. Therefore, it is suggested that :-

1. The Government considers allocating a higher highway and bridge development fund in the coming 7th, 8th and 9th plans,
2. A portion of the road user charges (such as road tax, and other users revenue) which become the General Federal Government Revenue at present should be specifically given to the development of highways.

Table 2 : Investment Requirements for Highway Development to Year 2010
(in RM million)

Category	Peninsular	Sabah	Sarawak	Malaysia
Expressways	8,134.1	-	-	8,134.1
Major Highways	14,030.5	4,213.2	3,724.2	21,967.9
Minor Highways	7,022.2	-	118.6	7,140.8
Primary Roads	6,917.0	3,879.1	4,967.2	15,763.3
Total	36,103.8	8,092.3	8,810.0	53,006.1

Source : Study Team estimates

(4) Implementation Programme

The technical and economic studies carried out in this study reveal that the following projects should be preferably implemented according to the implementation schedule.

Table 3: Implementation Programme for Future Highway Development to 2010
(in RM million)

Region	Phase I (1996-2000)	Phase II (2001-2005)	Phase III (2006-2010)
Peninsular Malaysia	8,236.6	11,336.6	16,530.6
Sabah	2,118.0	2,488.0	3,486.3
Sarawak	2,448.0	2,647.3	3,714.7
Total	12,802.6	16,471.9	23,731.6

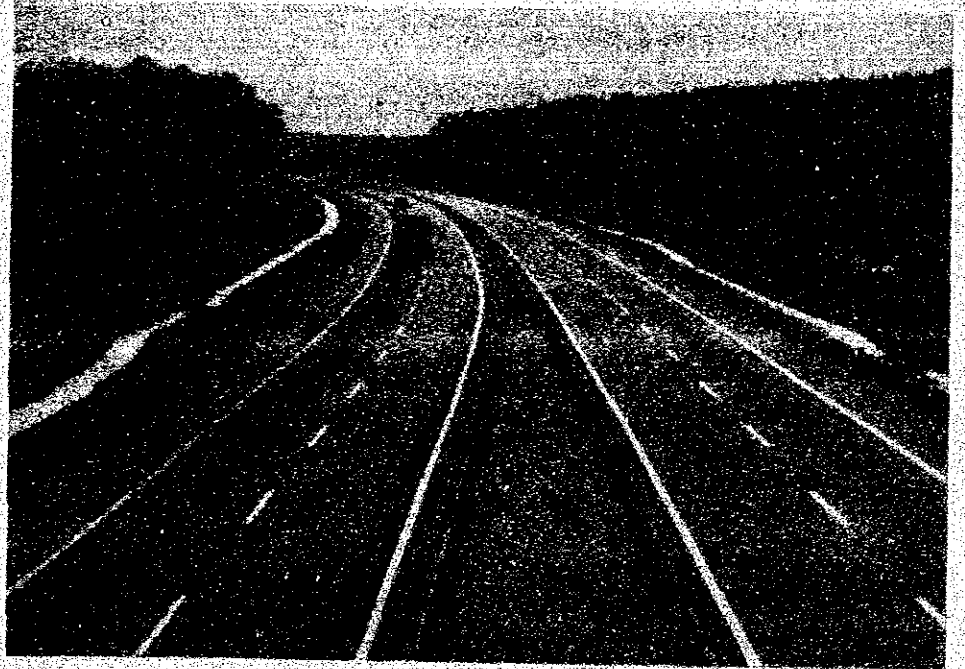
C. Recommendations

Based on the various findings and conclusions derived in this study, the following recommendations are put forward.

1. The proposed inter-urban highway network shall be developed as the main transport system in meeting future traffic demand in Malaysia.
2. To ensure that road transport is not over-burdened in future, the government of Malaysia has to encourage the use of other transport modes, particularly rail transport through modernization of the existing rail transport infrastructure, expanding its network and development of inland ports for the promotion of multi-modalism between rail and other modes in the country.
3. Highway development planning should strive for the achievement of a functional hierarchy system as proposed while urban bypasses shall be provided to relieve congestions around major urban areas.
4. More effective road safety programs are to be provided and supported with a revolving fund for its implementation. Facilities such as motorcycle lanes, pedestrian bridges or subways and grade separated accesses along expressways and major highways are to be provided to improve traffic safety.
5. Detail environmental impact assessment (EIA) studies must be carried out on all highway planning and construction to minimize the foreseeable adverse impacts on the natural environment.
6. The present privatization scheme is to be reviewed and further encouraged for development of highways in Malaysia through joint-ventures and cross-subsidy.
7. Examining the past road development expenditures by the Government of Malaysia, allocations for road development in the coming 7th, 8th and 9th Malaysia Plan will have to be increased in order to implement the proposed national highway network as planned. It is recommended that a portion of the road users revenue be allocated directly for road development.
8. Feasibility/engineering studies on the proposed priority highway projects are to be carried out as soon as possible. Four high priority projects are identified:
 - Kuala Lumpur Outer Ring Road/South Klang Valley Expressway,
 - Sabah and Sarawak Linkage
 - Kuala Lumpur - Kuantan Expressway
 - Port Dickson - Seremban Highway.
9. A periodical review of this HNDR study shall be conducted every five years to update the road development program.

CHAPTER 1

INTRODUCTION



NORTH SOUTH EXPRESSWAY

CHAPTER 1 : INTRODUCTION

1.1 Background To The Study

In response to the request by the Government of Malaysia for technical cooperation in conducting a Highway Network Development Plan Study in Malaysia (hereinafter referred to as HNDP Study), the Government of Japan, through the Japan International Cooperation Agency (JICA), dispatched a Study Team to carry out this Study.

The Study commenced on the 31st May, 1991 when the Steering Committee meeting was held and the Inception Report was endorsed. During the course of the Study, two (2) progress reports and two (2) interim reports were submitted to the Malaysian Government. This Final Report, submitted in March 1993, contains the final proposals for the comprehensive highway network development in Malaysia to the year 2010.

1.2 Objectives of Study

There are two main objectives to be achieved. These are:

- (1) To formulate a development plan of the national highway network up to the year 2010,
- (2) To prioritize new and improved linkages in the planned network with respect to technical and economic considerations and to formulate a road development program.

1.3 Study Area

The Study is to cover the whole 13 states of Malaysia and the Federal Territories. A map showing this Study Area is given in Figure 1.1.

The Study focuses primarily on inter-urban road network excluding intra-urban facilities such as bypasses and ring roads that do not affect inter-urban traffic.

1.4 Study Approach and Scope of Work

The Study for preparing the National Highway Network Development Plan is divided into three (3) phases:

Phase I: Formulation of Highway Development Concept Plan,
Phase II: Proposal for the National Highway Network Development Plan,
Phase III: Preparation of the Final Report.

The flowchart of the study phasing is shown in Figure 1.2.

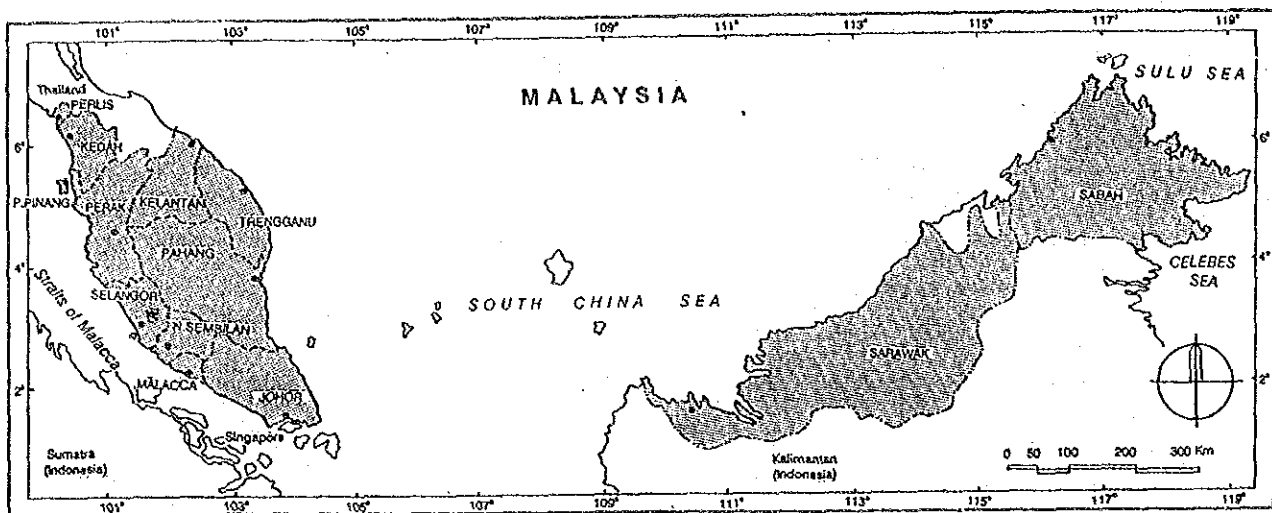


Figure 1.1 : Study Area

(1) Phase I: Formulation of Highway Development Concept Plan

The goal of this phase is to formulate the network development concept based on the National Development Policy (NDP), through examination of the data/information collected and analyses of existing traffic situations and forecast of future traffic demand taking into account the general economic and development trend in the country. The major tasks carried out in this phase were:

- (a) Reconnaissance survey,
- (b) Collection of existing data and information,
- (c) Hearings with state planning agencies/authorities,
- (d) Execution of traffic surveys,
 - vehicle owner interview survey,
 - roadside OD interview survey,
 - roadside traffic counting survey,
 - travel time survey,
 - travel mode survey in Sabah and Sarawak,
- (e) Collection of socio-economic framework data,
- (f) Setting of future planning framework,
- (g) Survey of existing highway network under study,
- (h) Road inventory survey,
- (i) Topographic and geological survey,
- (j) Traffic safety and management study,
- (k) Review of highway development organization and traffic regulations,
- (l) Analysis of traffic characteristics and preparation of existing OD matrices,
- (m) Forecasting of future traffic demand,
- (n) Identification of problems and issues on highway network development in Malaysia,

- (o) Formulation of highway network development concept plan,
- (p) Preparation and submission of Progress Report 1, 2 and Interim Report 1.

(2) Phase II : Proposal for the National Highway Network Development Plan

Building on the formulated concept plan in Phase I, major works conducted in Phase II include the analysis of travel demand on alternative road network plans, estimation of cost and benefits of these plans and their evaluation as indicated below. Finally, a highway network development plan for Malaysia to year 2010 is proposed, together with an implementation program after analyzing the country's financial situation in road development.

- (a) Traffic Demand Analysis of the Alternative Plans,
- (b) Transport cost analysis,
- (c) Estimate of benefits,
- (d) Preliminary design,
- (e) Setting of unit construction costs,
- (f) Project costs estimates,
- (g) Financial analyses,
- (h) Evaluation of alternative plans,
- (i) Preliminary environmental impact study,
- (j) Priority highway project listing and toll application,\
- (k) Draft proposals for the National Highway Network Development Plan to the year 2010,
- (l) Preparation and submission of Interim Report 2.

(3) Phase III: Preparation of Final Report

This Final Report is prepared based on the Draft Final Report and official comments received from the Government of Malaysia on the Draft Final Report. This Final Report is submitted to the Government of Malaysia in March 1993.

THE STUDY FLOWCHART

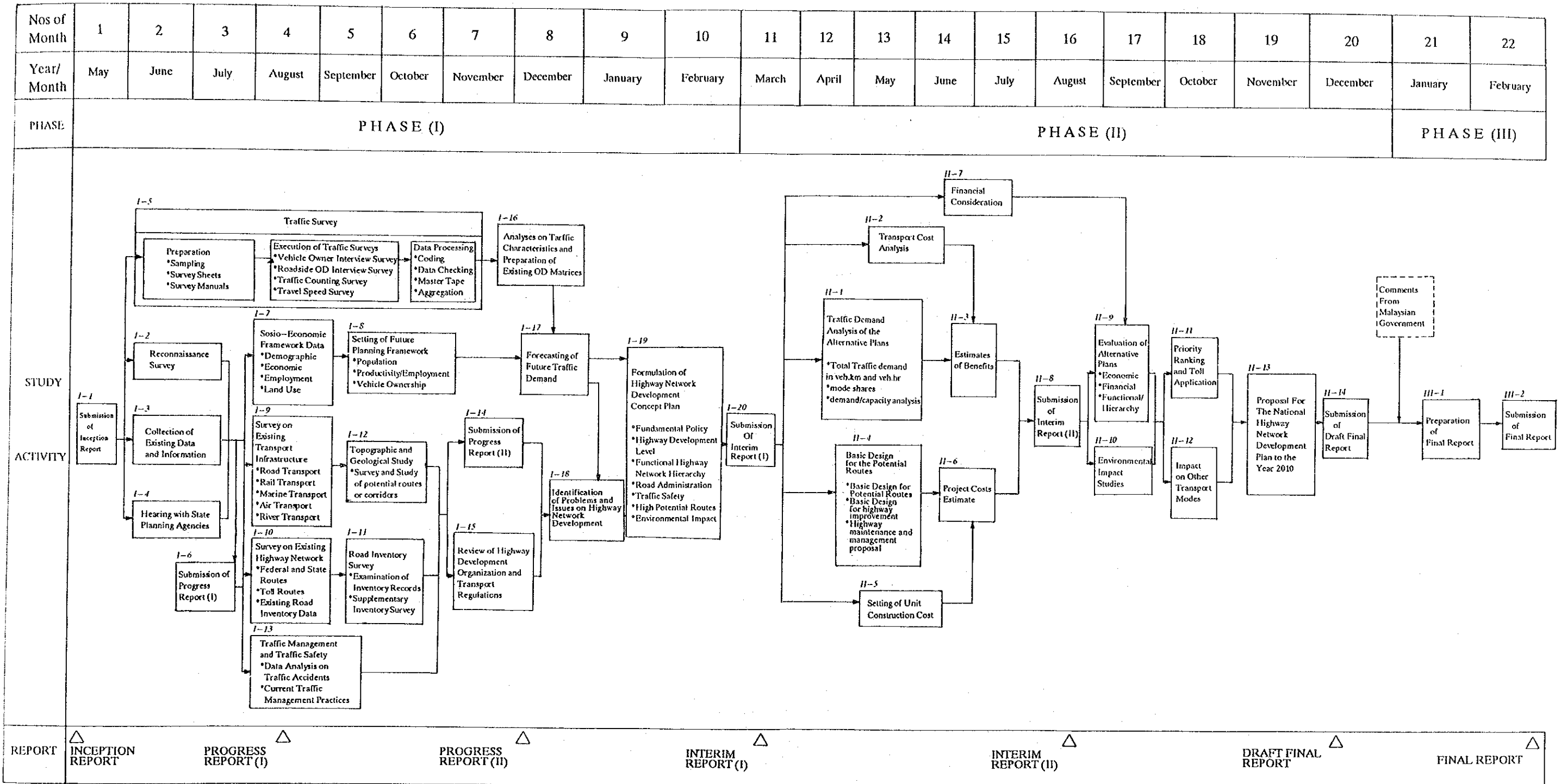


Figure 1.2: Flowchart of Study Approach and Phasing

1.5 Organization of the Study

The Study was conducted jointly by JICA and the Government of Malaysia in coordination with other related agencies. Committees were set up to facilitate consultations and discussion during the course of the Study. The organization for the Study is given in the figure below.

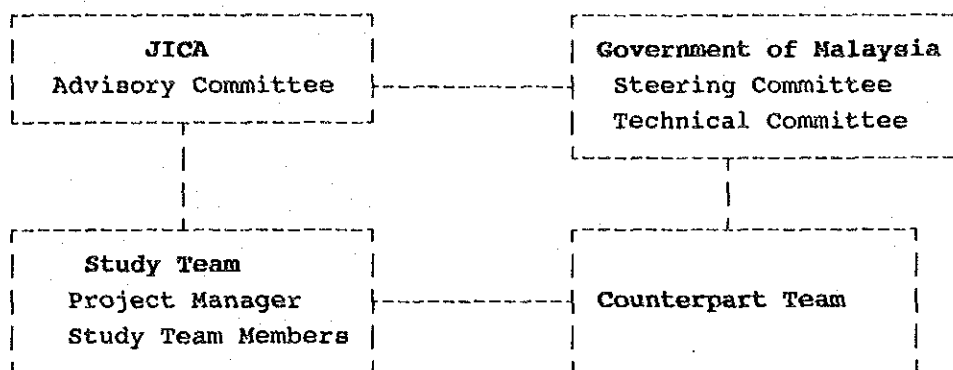


Figure 1.3: Organization Set Up For This Study

Steering Committee, Government of Malaysia

Chairman	Dato' Azizan Hussain (Oct. 89 until Dec. 91)	Deputy Director-General (Sectoral) Economic Planning Unit, Prime Minister's Department
	Dr. Samsuddin Hitam (Sept. 92 to-date)	Deputy Director-General (Sectoral) Economic Planning Unit
	Dr. Gan Khuan Poh (June 89 until Aug. 92)	Director, Infrastructur Division, Economic Planning Unit
	Mdm. Aida Boey Abdullah (Oct. 92 to-date)	Director, Infrastructur Division, Economic Planning Unit

Member	<ul style="list-style-type: none"> • Economic Planning Unit, Prime Minister's Department • Highway Planning Unit, Ministry of Works • Development Division, Ministry of Transport • Malaysian Highway Authority • Federal Department of Town and Country Planning, Malaysia • Public Works Department, Malaysia
--------	---

Advisory Committee, Government of Japan

Chairman	Mr. Hisakazu OISHI	Ministry of Construction
	Mr. Harutoshi YAMADA	Ministry of Construction
	Mr. Kimio MASU	Tokyo Metropolitan Government
	Mr. Naoki ORIMO	Japan Highway Public Corporation

Study Team

Mr. Kokuro HANAWA	Project Manager
Mr. Michimasa TAKAGI	Traffic Analysis/Forecasting
Mr. Toshio KIMURA	Traffic/Transport Planning
Mr. Yoshiteru SUNAGO	Regional Planning
Mr. Tadamichi HOSHI	Traffic Management
Mr. Satoshi KISHI	System Analysis
Mr. Kazuhiro NAGASE	Road Design
Mr. Akihiko KITAYAMA	Road Planning
Mr. Chua Mok You	Traffic Survey
Mr. Kouichi ETO	Traffic Survey
Mr. Adnan Zulkiple	Road Survey
Mr. Sakae TAKADA	Topography/Geology Survey
Mr. Toshisada KATSURADA	Economic/Financial Analysis

Embassy of Japan

Mr. Shunichi HAMADA
Mr. Makio SHICHIJO

Japan International Cooperation Agency (JICA)

Mr. Shinichi SAKAGUCHI	JICA Headquarter
Mr. Takeshi KANOME	JICA Headquarter
Mr. Satoru KOHIYAMA	JICA Malaysia Office
Mr. Kuniaki NAGATA	JICA Malaysia Office
Mr. Takao KAIBARA	JICA Malaysia Office
Ms. Yoshie YAMASHITA	JICA Malaysia Office
Mr. Yuzo YAMAMOTO	JICA Malaysia Office

CHAPTER 2

EXISTING TRANSPORT AND ROAD TRAFFIC SITUATIONS



ROADSIDE INTERVIEW SURVEY

CHAPTER 2 : EXISTING TRANSPORT AND ROAD TRAFFIC SITUATIONS

2.1 Traffic Surveys

To understand the existing travel pattern and mode shares in the Study Area as well as to obtain traffic demand information for the forecasting of future traffic demand, seven different traffic surveys were conducted between July and December of 1991. The surveys covered the entire Peninsular Malaysia, Sabah and Sarawak. The extensive scope and area of these surveys necessitated the setting up of 6 survey regional offices and 36 survey site offices throughout Malaysia involving more than 2,000 survey persons.

1. Vehicle Owner Interview Survey

This survey was conducted in Peninsular Malaysia where more than 50,000 vehicle owners (except motorcycles and trailers) were interviewed on their socio-economic status and trip characteristics. This survey was essential for the calibration of trip generation and attraction models and the trips enumerated were used for the construction of the existing OD matrix.

2. Roadside Interview Survey

This roadside interview survey was conducted at 63 strategic locations on the federal roads in Peninsular Malaysia and 5 locations in Sabah to enumerate long distance trips across state boundaries and screen lines. Trips enumerated in this survey are also vital for the construction of the existing OD matrix.

3. Roadside Counting Survey

The roadside counting survey results were used for expansion of trips enumerated by the roadside interview survey. Moreover, these traffic volume data at the survey locations are important for screen line checking after the existing traffic demand is established.

4. Travel Speed Survey

The travel speed on some 5,600 km of 19 major federal roads in Peninsular Malaysia was surveyed. The data is essential to establish the level of accessibility as well as an important input for trip assignment model.

5. Travel Mode Interview Survey

In place of the vehicle owner interview survey, this survey was designed for Sabah and Sarawak. Members of about 2,000 households were interviewed for their modes of travel as well as characteristics of their vehicle trips. Results of this survey and the roadside counting were used to update the available OD table.

6. Air and Water Transport Surveys

As air and water transport are important modes in Sabah and Sarawak, surveys for enumerating these trips were also conducted at ship wharfs, ferry terminals as well as airports.

Table 2.1: Summary of All Traffic Surveys Carried Out

No.	Type of Survey	Actual Sample Size/Points	Survey Area	Period of Survey
1.	Vehicle Owner Interview Survey (OIS)	49223 (2.4%)*	P.Malaysia	July-Dec.1991
2.	Roadside Interview Survey (RIS)	63 points 5 points	P.Malaysia Sabah	July-Oct.1991 Dec.1991
3.	Roadside Counting Survey (RCS)	63 points 10 points	P.Malaysia Sabah & Sarawak	July-Oct.1991 Dec.1991
4.	Travel Speed Survey	5662 km	P.Malaysia	Sept-Oct.1991
5.	Travel Mode Survey	932 HH** 1037 HH	Sabah Sarawak	Dec.1991 Dec.1991
6.	Water Transport Survey	4 points	Sarawak	Dec.1991
7.	Air Transport Survey	4 points	Sabah	Dec.1991

* Percent to total registered vehicle population in P.Malaysia as of Feb.1991

** Households

All data collected from the above surveys were coded, input into computer, checked and processed before being expanded to represent the total travel characteristics in the Study Area.

2.2 Existing Transport System

The national transport system is comprised of the four major modes of road, rail, air and maritime transport. Road transport remains the most important mode both for goods and passengers in the country. The infrastructure for these modes in 1990 are summarized below:

Of the total 63,445 km of roads, 49,909 km or 79% are in Peninsular Malaysia, 8,658 km or 13% in Sabah and 8% in Sarawak. Only 74% of the total roads are paved.

KTM (The Malayan Railway) operates about 298 passenger coaches and 8259 freight wagons on the 1,643km of meter gauge rail lines in P.Malaysia which consisted of two routes - a west coast line from Singapore-KL-Butterworth-Pdg.Besar and a east coast route from Gemas-K.Lipis-Tumpat.

Table 2.2: Summary of Transport Infrastructure in Malaysia in 1990

	Peninsular	Sabah	Sarawak	Total
Roads	49,909 km	8,658 km	4,878 km	63,445 km
Railways	1,643 km	84 km	-	1,727 km
Major/Minor Ports	9	8	4	21
Int. Airports	4	1	1	6
Domestic A/P	6	4	3	13
Airstrips	13	10	15	38

Sources: Transport Statistics, Annual Bulletin of Statistics, Sabah; Annual Statistical Bulletin, Sarawak and the Sixth Malaysia Plan

Note: Number in brackets denotes percentage

The Sabah State Railway operates the other only railway line in Malaysia from Tanjung Aru to Tenom for a distance of 84km. This rail line carried about 477,000 persons in 1991 and 15.45 million kg of freight in 1989.

There are a total of 21 major and minor ports in Malaysia, of which 9 are in P.Malaysia, 8 in Sabah and 4 in Sarawak. Marine transport is an important mode of transport in Sarawak.

Of the total marine cargo throughput of 100.1 million tonnes in 1990, 58% was handled by ports in P.Malaysia, followed by 29% in Sarawak and 13% in Sabah. The percentage share of Sarawak is substantial.

There are now 6 international airports in the country capable of handling wide-bodied aircrafts. The 13 domestic airports are served by the national carrier MAS. Besides these, there are 38 other minor airports or airstrips.

Of the total 17.3 million air passenger traffic in 1990, 11.3 million (65%) were in Peninsular Malaysia, 3.0 million (17.5%) in Sabah and 3.0 million (17.5%) in Sarawak. The total number of international and domestic air passengers were 5.9 million (34%) and 11.4 million (66%) respectively.

The total cargo handled by airports in Malaysia 1990 was 241,400 tonnes. Of the total, 84% was handled in P.Malaysia, 11% in Sabah and 5% in Sarawak. Furthermore, 74% of the total was international cargo and only 26% was domestic.

The existing transport system in Malaysia is thus dominated by road transport and this trend will continue into the future. This is supported by the trend in the country's infrastructure investment on road transport.

Rail transport has not been developed along with road transport in the past decades to provide better services both in passenger and cargo transport in the country. In terms of percentage share, it has in fact declined over the years although in real terms, rail passenger transport has increased. Without an extensive rail transport