CHAPTER I

INTRODUCTION

1.1 Background to the study

Thailand has a population of about 44 million in 1977 and area of 514,000 square kilometers. Although average population density in 1977 was 81 persons per square kilometer and 85 percent of population is in the rural area, the growth of urban population, especially in Bangkok, was as high as about 5 percent while the national average was 2.7 percent.

The average rate of growth of the economy in 1970's has been decreased to 6 percent from 9 percent in 1960's. However, growth rate in 1976 showed a recovery from that in 1974 affected by oil crisis. Out of gross demestic product in 1977, 370 billion Bahts, 20.1 percent was earned by the agricultural sector.

Agriculture is still predominant economic sector, having 63 percent of total labour force and sharing 50 to 60 percent of total value of exports. Major exported crops include rice, sugar, tapioca, rubber and maize. Despite the great importance of agriculture in the national economy, recent growth of the sector has been decreased. The average growth in the Third Plan was 3.9 percent against the planning target of 5 percent. Thus, in the future regional development program, much attention is paid to the recovery of agricultural production in order to redress the regional balance.

In the Fourth National Economic and Social Development Plan (1977-1981), particular emphasis is placed, on the objective of regional balance and the Plan seeks to achieve: decentralization of public investment, development of rural infrastructure, reduction of rate of population growth and dispersion of industries away from Bangkok so as to increase employment opportunities and regional incomes in rural area. From the viewpoint of the redressing of regional balance, much attention is paid to the recovery of the agricultural production together with the improvement of rural road networks.

More than 10 percent of population of Thailand centers in the Bangkok Metropolitan Area. At the end of 1977, the population in Bangkok was 4,743,000. The pattern of movement for goods and passengers reflect this dominant position of Bangkok in the economy of Thailand. Primary and agricultural products are carried to Bangkok for export, processing and local consumption, while imported and locally manufactured industrial products are moved in the opposite direction. To accommodate these flows, a radial transportation system has evolved with Bangkok at the center. The road transport is a dominant mode in the system with rail and water transportation following.

The public road networks had about 12,900 kilometers of national roads and about 9,900 kilometers of provincial roads in 1977. The national road system connects the main towns and regional centers throughout the country. The provincial road system links districts and other important centers or areas to provincial capitals. Since 1963 to 1977, the national road system has expanded from 9,100 to 12,900 kilometers, and the percentage of paved sections has increased from 46 to 94 percent. At the same time, the provincial road system has expanded from 2,200 to 9,900 kilometers, and the percentage of paved section has increased from 9 to 49 percent. Besides the above 9,900 kilometers of provincial roads, there are 14,000 kilometers of unimproved provincial road which recieve only minimum maintenance or are under construction or improvement. As they were not constructed to a sufficient standards, many sections become impassable in rainy seasons. About 60,000 kilometers of local roads, which connect villages to national and provincial road systems, are also included in the public road networks.

The Fourth National Economic and Social Development Plan (1977-1981) includes an allocation of about 31 billion Bahts for transport sector, or about 12 percent of the total development expenditure. Road investments are about 22.3 billion Bahts, or about 73 percent of the transport allocations.

Based on the above-mentioned background, the authority, which concerned to road construction and improvement, must pay close attention to the economic design of highways and maintenance programs.

But how are they to decide priorities? What is the benefit to society of another currency unit spent on maintenance compared to another currency unit spent on new roads or improvement or new investment in some other sector? Is it more economical to spend a bit more money to construct a stronger pavement initially and thereby save future outlays on maintenance or alternatively would they follow a stage construction strategy, economizing on the initial construction and paying a bit more in the way of maintenance and upgrading cost later on, when uncertainties about traffic growth will have been resolved? How much, or how little, would they spend to maintain paved roads and how much to maintain gravel and earth roads? Does it matter much if maintenance outlays are postponed during years of financial stringency? These are important questions which urgently need answering. At the present time, Highway Design and Maintenance Standards Model (HDM), that was developed by the World Bank, is one of the tools which help to search for the answers to these questions.

1.2 Evolution of the HDM Model and Its Empirical Validation

The basic problem in ditermining economic design and maintenance standards for a given road project is to predict, in a specified location, total road transport costs -- construction plus maintenance plus road user costs -- as a function of the road design and maintenance standards which may be adopted. The objective is to search out that combination of standards which result in minimum total costs to society including the costs to road users as well as the costs born by the highway authority. To have a generally applicable tool, one must know the effects of different environments (terrain, climate, traffic, driver behavior) on the different cost components. To search many alternative design and maintenance strategies to determine the most economic, there must be a capability for the rapid calculation of alternative cost streams (which may extend to twenty years or more).

Therefore in 1969 the World Bank (International Bank for Reconstruction and Development, IBRD) in conjunction with research institutions in the united states, United Kingdom and France, initiated a major program of research to develop a new decision-making framework for evaluating alternative design and maintenance strategies for low volume roads. Phase I of the study, conducted by a research group at the Massachusetts Institute of Technology and completed in 1971, developed a conceptual framework for inter-relating construction, maintenance and vehicle operating costs so that total highway costs may be minimized. Subsequent efforts have focused largely on empirical research involving field collection of primary information on the underlying physical and economic relationships, particularly vehicle speed and operating costs and road deterioration related to design and maintenance standards. The first such study was done in Africa (Kenya) by the U.K. Transport and Road Research laboratory (TRRL) in collaboration with the Kenya Ministry of Works and the World Bank. In the process the TRRL redeveloped and extended the original MIT/IBRD model in its Road Transport Invesment Model (RTIM) based on its research in Kenya and elsewhere.

The original MIT model and subsequent TRRL (RTIM) model were designed as tools to calculate total transport costs on one route. The output formats are simply in terms of cost and these models do not include endogeneous facilities for economic comparisons among alternatives. Therefore, a collaborative effort was undertaken in 1976-77 to develope a unified Highway Design and Maintenance Standards Model (HDM) to incorporate the best features of the MIT and RTIM models and provide capacity for economic analyse of multiple alternatives and multiple routes. After gaining some experience with using the resulting prototype in several Bank highway project appraisals, further work was undertaken at the Bank to modify and enhance the model. This work led to the present HDM version which incorporates a number of new user-oriented features, including an extensive input data diagnostic facility, an expanded set of options for performing road maintenance operations and estimating vehicle operating costs, and additional management-oriented reports. Unlike the RTIM model, however, the HDM does not yet include a submodel to estimate the costs of road construction endogenously; construction costs are to be specified by the user.

The HDM model is now being used to design maintenance programs and evaluate proposed projects in several countries and to guide further research.

1.3 Applications of the HDM Model

Within the model framework and the limitations of the underlying empirical relationship, the model can be employed in a variety of applications ranging from project-level pre-feasibility and feasibility studies to highway sector resource-allocation planning. For example, the model can be used:

- to search for appropriate new vertical and new horizontal alignments for a given traffic volume and topography;
- to determine appropriate type of improvements on the existing alignment, such as surface upgrading and rehabilitation;
- to determine an "optimal" size and composition of a national or regional road maintenance program; and
- to allocate national highway sector investment to functional classes, regions, types of road betterment, and road maintenance.

Over the range of model applicability, the quaility and level of aggregation of input data required vary according to the nature of the application. In general, the higher the level of planning, the more aggregate the input data become. For example, for a project-level feasibility study dealing with alternative road alignments, the geometric characteristics may be provided in some detail, section-by-section. On the other hand, in the development of a maintenance program for a regional road network, road surface and geometric characteristics may be input as average characteristics for large classes of roads by surface type and traffic range.

1.4 Objectives, Scope and Limitations of the Study

The Highway Design and Maintenance Standards Model (HDM) is applied to the Tha Maduk-Sri Thep provincial road, which has already been constructed in 1977 by Productivity Roads Office, Department of Highways.

The specific objectives of the present study are:

1. to determine the most theoretical suitable road surface improvement type for the Tha Maduk-Sri Thep provincial road, and
2. to determine the most theoretical suitable maintenance policy and maintenance standards that would be applied to the completed construction road.

Descriptions of the input data included some adjustments and approximations which become necessary because of an unsuitable or inadequate data which were available. Some of the significant limitations of the HDM Model which make it difficult to use in Thailand are discussed.

1.5 Sources of the data

Most part of the data use in the study were gathered from final report on feasibility study for Phetchabun-Chai Badan highway project, which was done by Japan International Cooperation Agency(JICA) in March 1979, and from some of Thailand Highway Department's documents and field survey collection for the remainder. When data were lacked some informations need to be assumed, based on reasonable values. In addition, it was, occasionally, necessary to revert to the default options of the model. (Default value based on Kenya condition)

TABLE 1.1 NATIONAL AND PROVINCIAL ROADS

(km)

Year	National roads			Provincial roads		
	Paved	Gravel	Total	Paved	Gravel	Total
1963	4,157	4,917	9,074	202	1,998	2,200
1964	4,702	4,702	9,404	257	1,957	2,214
1965	5,046	4,436	9,482	405	2,389	2,794
1966	5,008	4,490	9,498	427	2,569	2,996
1967	5,507	4,011	9,518	581	3,311	3,892
1968	6,613	3,131	9,744	1,131	4,078	5,209
1969	7,822	2,146	9,968	1,281	4,448	5,729
1970	8,620	1,781	10,401	1,479	4,413	5,892
1971	9,681	1,296	10,977	1,781	4,347	6,128
1972	10,493	1,014	11,507	2,288	3,891	6,179
1973	11,065	1,008	12,073	2,560	4,039	6,599
1974	11,750	747	12,497	3,025	3,986	7,011
1975	11,840	818	12,658	3,396	4,043	7,439
1976	11,968	752	12,720	4,276	4,601	8,877
1977	12,134	722	12,856	4,920	5,022	9,942

SOURCE: JAPAN INTERNATIONAL COOPERATION AGENCY, VOL. 1, 1980 (TABLE 2-1)