Acknowledgement

Throughout the period of the Study of the Competency Improvement System of the Transport and Traffic Management Development Plan Project, the Consultant received full support from all parties concerned, enabling smooth and complete performance towards the objectives of the Project.

The Consultant wishes to thank the Steering Committee of the Competency Improvement System of the Transport and Traffic Management Development Plan Project for the useful comments and advice regarding the work of the Consultant including assistance in coordination with other relevant agencies. The Consultant also wishes to thank representatives of those agencies for providing the Consultant with all data and information needed for project implementation, including their participation and exchange of opinion in the seminars and workshops organized by the Consultant. This is enabled the Consultant to enhance the standard of the work undertaken.

Thanks also given to the Director General of the Office of Transport and Traffic Policy and Planning, and all staff of the Office of Transport and Traffic Policy and Planning who always provided support, in every aspect, to the Consultant.

Finally, the Consultant wishes to give special thanks to the Office of Transport and Traffic Policy and Planning for the trust given to the Consultant throughout the period of this Study.

The Consultant

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Introduction

Presently, the World economy and that of Thailand are changing rapidly. Any such change in a large economy country such as the USA, China and member countries of OPEC will consequently affect the Thai economy. Therefore, the Royal Thai Government (government) needs to reform its management structure to be more flexible and able to respond efficiently. The role of government agencies should be clear, not overlap and should place emphasis on supporting the economic development of the private sector.

Government agencies must reform their public service management concept by improving the process of budget preparation and allocation, termed Strategic Performance Based Budgeting: SPBB, and by making each Minister responsible for their own Public Service Agreement – PSA.

The Transport Minister has determined budgeting preparation policy for the year 2004 for the Ministry of Transport (MOT). It should produce 4 tangible outcomes in order to conform with Strategic Performance Based Budgeting as follows:

1) To develop a Logistics System to enhance capacity of service and commercial competitiveness;
2) To develop public transport services with safety, speed, and accessibility;
3) To create equilibrium of transport infrastructure utilization (road/rail/water/air) by determining Key Performance Indicators (KPIs) and Public Service Goals; and
4) To determine KPIs and Public Service Goals comprising 6 targets.

In order to achieve the MOT Public Service Goal of achieving efficiency at the lowest budget, government agencies and public enterprises under the supervision of the MOT should work together, systematically and efficiently.

The main responsibilities of the Office of Transport and Traffic Policy and Planning (OTP) are to recommend policies, formulate transport and traffic plans and to formulate transport safety plans. OTP must also ensure that the various transport and traffic plans for land, water, air and safety plans are co-ordinated and are consistent with the Transport and Traffic Master Plan. Consequently, OTP needs to develop the Competency Improvement System of the Transport and Traffic Management Development Plan.

Scope of Work

The scope of work of the Competency Improvement System of the Transport and Traffic Management Development Plan includes the following.

1) Development of databases of origin-destination data for the transport of commodities and passengers, including databases on transport cost data. Such databases must be digitalized to enable data entry and data enquiry as well as enabling their use as tools for analyzing, making decisions, evaluating, including monitoring of the setting of public service targets;
2) Formulation of models for processing of data in the databases, forecasting future changes of such data and evaluating public service targets, KPIs and monitoring, including systems for following up;
3) Study and analysis for setting public service targets;
4) Formulation of the monitoring system, including a following-up process; and
5) Training of appropriate personnel of OTP and other related agencies.

1. Development of Databases of Transport Flow Data for Commodities and Passengers, and Transport Costs

1.1 Development of Databases of Transport Flow Data for Commodities and Passengers

Transport flow databases for the origin-destination of transport of commodities and passengers have been completed. Four commodities were selected for detailed studies. These commodities are milled rice, automotive parts, cement and petroleum. The commodity flow databases were classified by commodity types and modes of transport. The classified transport modes were those of road, rail, water, air and pipeline. Databases for passenger flow were classified by travel mode; bus, rail and air.

Transport flow databases of commodities and passengers for the years 2004-2011 were constructed. Data were forecasted data, classified according to commodity types and modes of transport. These can be summarized in the following Tables.

Table 1-1 Forecasts of Volume of Milled Rice Transported for Export, Classified by Mode of Transport, 2004-2011

Unit: 1,000 tons / year

Mode of Transport	2004	2005	2006	2007	2008	2009	2010	2011
Trucks	9,500	10,000	10,400	10,900	11,400	12,000	12,400	13,000
Waterways	600	700	800	900	900	1,000	1,100	1,200
Total	10,100	10,700	11,200	11,800	12,300	13,000	13,500	14.200

Table1-2 Forecasts of Volume of Automotive Parts Transported, Classified by Mode of Transport, 2004-2011

Unit:1,000 tons / year

Mode of Transport	2004	2005	2006	2007	2008	2009	2010	2011
Trucks	900	1,600	1,800	2,000	2,400	2,700	3,100	3,500

Table1-3 Forecasts of Volume of Cement Transported, Classified by Mode of Transport, 2004-2011

Unit: 1,000 tons / year

Mode of Transport	2004	2005	2006	2007	2008	2009	2010	2011
Coastal	1,800	1,800	1,800	1,900	1,900	1,900	2,000	2,000
Railways	5,300	5,400	5,500	5,600	5,700	5,800	5,900	6,000
Trucks	28,500	28,800	29,300	29,800	30,400	31,000	31,700	32,400
Total	35,600	36,000	36,600	37,300	38,000	38,700	39,600	40,400

Table 1-4 Forecasts of Volume of Petroleum Transported, Classified by Mode of Transport, 2004-2011

Unit: 1,000 tons / year

Mode of Transport	2004	2005	2006	2007	2008	2009	2010	2011
Railways	1,500	1,600	1,700	1,800	1,900	1,900	2,000	2,100
Trucks	18,500	18,500	20,400	21,400	22,500	23,600	24,800	26,000
Pipelines	7,700	8,100	8,500	8,900	9,400	9,900	10,400	10,900
Waterways	500	500	600	600	600	700	700	700
Coastal	12,200	12,800	13,400	14,100	14,800	15,600	16,300	17,100
Total	40,400	41,500	44,600	46,800	49,200	51,700	54,200	56,800

Table 1-5 Forecasts of Volume of Passengers Transported, Classified by Mode of Transport, 2004-2011

Unit: 1,000 passenger-trips / year

Mode of Transport	2004	2005	2006	2007	2008	2009	2010	2011
Airways	8,700	8,900	9,200	9,400	9,700	9,900	10,300	10,600
Railways	54,400	56,000	57,600	59,400	61,200	63,200	65,200	67,400
Buses	234,300	238,900	243,600	248,300	253,000	257,600	262,300	267,000
Total	297,400	303,800	310,400	317,100	323,900	330,700	337,800	345,000

1.2 Development of Databases for Transport Costs

Overview of Thailand Transport Sector.

Thailand's transport sector has to date been inefficient relative to many other developed countries. Utilization of transport infrastructure in each mode has been unbalanced, as the share of road transport is much higher than that of other modes, such as rail and water transport, despite the fact that the actual transport costs of these modes are lower than that of road. This has resulted in increased transport cost for the country as a whole. From analysis conducted during this Project, the causes of the increasing transport cost are as follows:

(i) Public sector transport planning in the past focused on transport infrastructure investment with relatively low cost per distance, fast implementation time and high accessibility. This strategy has led to the vast expansion of the road network, while the development of rail and water transport networks has been given lower priority, although these modes of transport would result in lower transport cost in long term. In countries where transport sector development has been successful, transport infrastructure investment is integrated across the modes. In many cases, rail and/or water transport has been planned to be the back-bone systems and the road network is considered to be a support system which enhances linkages and distribution.

(ii) Another important factor is the administrative problem in transport planning. The failure of transport management over the years has brought about delay, inconsistent service and costly transport, leading to disincentive in the use of public transport compared with private transport. This situation is self-feeding: the imbalance in the transport demands for private and public transport requires more road transport infrastructure.

Poor management in transport not only leads to waste energy, but also erodes the competitive edge of the country. Inefficient transport systems lead to high logistic costs resulting in unnecessary costs of production, society losses from accidents occurring because of excessive road transport and several negative externalities such as air pollution, noise and stress from traffic congestion. These produce economic loss and serious harm to the people's quality of life.

Compared with other countries, the transport system of Thailand is far from efficient. One indicator that has been used is the comparison between energy consumption in the transport sector and the overall consumption. There are only two countries, Thailand and the United States, which in the past have used more energy in transport than in industrial sector. These two countries consumed approximately 40 percent of total energy in transport. According to a study of transport energy use in Thailand, approximately 440 billion baht annually is spent in transport, this amount accounts for 58 percent of the total energy using in Thailand. The study also indicated that the country spent about 300 billion baht annually on importing energy.

But, problems can be solved. Transport restructuring requires that every authority should collaborate in constructing a better transport system. Consequently, such collaboration will be of benefit not only from cost saving but also from natural resource use. Most importantly, studies of the cost structure of transport will help to focus transport policy planning in Thailand in the appropriate direction for the future.

Concept of Transport Costs by Road, Rail, Water, Air and Pipeline

Transport costs can be broken down into operator costs, government costs, user costs and external costs.

1) **Operator costs** are those related to transport services provided by the operator from the origin to the destination. Operator costs can be classified into two categories as:

(i) Costs of unit-related activities or costs that vary according to volumes of production such as wages and fuel expenses.

(ii) Costs of product-sustaining activities or fixed costs such as office expenses, rent, insurance and interest.

2) **Government costs** are those incurred by the government in providing the transport system of the country. Such costs are, construction and development costs, including maintenance costs, for transport infrastructure and facilities.

3) **User costs** are the expenses incurred by users of transport services such as charges for services in the case of transporting goods, or the ticket and fee charges in the case of transporting passengers.

4) **External costs** are those that can be viewed as economic costs though they are not recorded in the accounts. These external costs are derived from the economic activities in the transport sector and are borne by the community and include such costs as the costs of accidents, congestion and pollution. The external costs considered in this study are those that are not paid by the operators, the service users, or the government.

Method of Constructing an Operator Cost Structure

Emphasis on the calculation of operator costs has been made because this can be compared across competing modes of transport and can be used to evaluate the government budget for infrastructure investment. In this study, the costs of transport including related costs incurred by all operators in the process of transport are called “Total Transport Costs” or “Total Logistic Costs” covering all costs in all stages of the supply chain.

An operator cost structure has been constructed as follows:

$$\boxed{Y_{it} = a_{it} + B_1 X_{1t} + B_2 X_{2t} + B_3 X_{3t} + B_4 X_{4t} + B_5 X_{5t} + B_6 X_{6t} + B_7 X_{7t} + B_8 X_{8t} + e_{it}}$$

Where Y_{it} is the operator cost on route i at the time t

a_{it} is a fixed coefficient

X_{jt} where j = 1, 2, 3 ....., 8 are variables affecting cost structure

X_{1t} is fuel price

X_{2t} is wage

X_{3t} is maintenance expense

X_{4t} is other direct expense

X_{5t} is office expense

X_{6t} is interest to be paid

X_{7t} is fee and tax

X_{8t} is other indirect expense

e_{it} is other independent variable affecting cost structure

All the variables vary according to different factors. For commodity transport, the following coefficients are:

B_1 = fn (loaded weight, hour of work, vehicle type, fuel price, ...)

B_2 = fn (length of haul or trip, loaded weight, vehicle type, ...)

B_3 = fn (loaded weight, vehicle type and utilization characteristic of maintenance, ...)

B_4 = fn (length of haul or trip, value of vehicle, loaded weight, ...)

$B_5 – B_8$ = Constant values based on vehicle types

With regard to this study, 17 cost models for the transport of commodities and 27 cost models for the transport of passengers have been constructed and classified by mode of transport and type of vehicle as follows (details are shown in the Appendix).

Transport Cost Models for Passengers

Total cost of transporting passengers (Baht/person-kms) = operator cost + government cost + external cost where length is in kms, fuel price in Baht/Liter, number of passengers in passengers/trip and number of trips in trips/day:

1) Total transport cost by road

- 1.1) by BMTA bus (ordinary)
- 1.2) by BMTA bus (air-conditioned, Euro II)
- 1.3) by private bus (ordinary)
- 1.4) by private bus (air-conditioned)
- 1.5) by minibus
- 1.6) by van bus
- 1.7) by category IV bus
- 1.8) by microbus
- 1.9) by taxi
- 1.10) by Category II bus, Standard 1 A (24 seats)
- 1.11) by Category II bus, Standard 1 B Special (32 seats)
- 1.12) by Category II bus, Standard 1 B (40 seats)
- 1.13) by Category II bus, Standard 2
- 1.14) by Category III bus, Standard 1 B
- 1.15) by Category III bus, Standard 3
- 1.16) by Category IV bus (outside Bangkok)
- 1.17) by 6 wheel tourist bus in town
- 1.18) by 6 wheel tourist bus within the range of 300 kms.
- 1.19) by 6 wheel tourist bus with the range of more than 300 kms.

2) Total transport cost by rail

- 2.1) by urban rail
- 2.2) by BTS

3) Total transport cost by water

- 3.1) by ordinary express ferry in the Chao Phraya River
- 3.2) by yellow-flag express ferry in the Chao Phraya River

3.3) by express ferry in Khlong Saen Saeb

3.4) by cross-river ferry

4) Total transport cost by domestic air

4.1) by new purchased aircraft

4.2) by second-hand aircraft

Transport Cost Models for Commodities

Total cost of commodities transport (Baht/ton-kms) = operator cost + government cost + external cost

where length is in kms, weight in tons, fuel price in Baht/liter.

1) Total transport cost of agricultural commodity

1.1) road transport by 10-wheel truck

1.2) road transport by semi-trailer (18 wheels)

1.3) waterway transport by river tugboat

1.4) air transport by leased aircraft, both excluding and including of fuel, and pilot

2) Total transport cost of manufacturing commodity

2.1) road transport by 4-wheel truck

2.2) road transport by 6-wheel truck

2.3) road transport by semi-trailer (18 wheels)

2.4) road transport by 10-wheel truck (refrigerated)

2.5) rail transport

2.6) air transport by leased aircraft, both excluding and including of fuel and pilot

3) Total transport cost of construction materials

3.1) road transport by semi-trailer (18 wheels)

3.2) rail transport

3.3) waterway transport by river tugboat

4) Total transport cost of petroleum

   4.1) road transport by semi-trailer (18 wheels)

   4.2) rail transport

   4.3) coastal freighter of petroleum by tank carrier

   4.4) by pipeline

These transport cost models will be used to analyze various aspect such as creating the equilibrium in infrastructure utilization (the equilibrium condition obtained when the proportion of transport usage by each mode is such that the total national costs are minimized), the impact of changing of fuel price on the cost of various modes of transport, setting the passenger fare by different load factors and the analysis of energy consumption in passenger transport in terms of economic loss by comparing the different values of annual fuel consumption in public and private transport. Examples of transport cost and operator cost calculation are as follows.

Example of total transport cost and operator cost calculations

Category-II Bus (32 seats) on Bangkok – Nakon Rachasima route

Total transport cost for Category-2 Bus (32 seats) equals the operator cost *plus* government cost *plus* external cost, which equals to:

[0.360dfm+6472.00]/[nmd] + 4561/nd + 3.135/n (unit: Baht/passenger-km.)

Total transport cost – at diesel price of 21.19 Baht/liter (f = 21.19)

Operator cost = 20.075/n Baht/passenger-km., or 20.075 Baht/km.

Route attributes:

Distance (d) = 260 kms.

Frequency (m) = 2 trips/day

At 100% occupancy (32 passengers/trip), total transport cost = 1.273 Baht/passenger-km.

At 90% occupancy (29 passengers/trip), total transport cost = 1.405 Baht/passenger-km.

At 80% occupancy (26 passengers/trip), total transport cost = 1.567 Baht/passenger-km.

These total transport costs will be used in the analysis process of equilibrium model at a later stage.

In addition, the above cost model can be used to analyze other issues such as fare levels, by using the operator cost portion of the cost model (in this case: [0.360dfm+6472.00]/[nmd]). Therefore:

At 100% occupancy (32 passengers/trip),	operator cost = 0.627 Baht/passenger-km.
At 90% occupancy (29 passengers/trip),	operator cost = 0.692 Baht/passenger-km.
At 80% occupancy (26 passengers/trip),	operator cost = 0.772 Baht/passenger-km.

The databases of origin-destination of commodity and passenger transport flow, including databases of transport cost, must be digitalized so that data entry and data enquiry are enabled and so that they can be used as tools for analyzing, making decisions, evaluating and for monitoring of the setting of public service targets.

2. The Study of Infrastructure Utilization and Its Equilibrium

The key objective of the study of infrastructure utilization and its equilibrium is to provide the overview picture of the infrastructure of the country, the investment by the government and the current uses of each type of transport infrastructure in order to define the causes of the unbalanced utilization of infrastructure. Outcomes of the analysis can be used to support the analysis of the equilibrium of the transport infrastructure of the country, evaluation of the economic impact of the unbalanced investment in infrastructure, recommendations to achieve equilibrium use of infrastructure and the determination of key performance indicators for the public service agreement in equilibrium conditions.

The study shows that current utilization of infrastructure is unbalanced (particularly from the public investment point of view) for a number of reasons, such as planning and budget allocation processes. Lack of coordination between concerned agencies also delays planned work since there is no core agency with the sole authority for making decisions. In addition, many operators are faced with problems derived from rules and regulations.

After finding the causes obstructing the achievement of transport equilibrium, equations or models for analyzing the equilibrium in transport have been developed. The input was based on the databases of origin-destination of commodity and passenger transport flow, including databases of transport costs. The main assumptions are:

1) Equilibrium in transport can be obtained only when the demand for transport is equal to the supply of transport infrastructure and/or transport services. In such a situation, the total transport cost borne by the country, including external cost will be minimized.

2) The above total cost is a virtual cost since it includes factors that cannot be valued in terms of money. Such factors are important because they affect the demand for transport and must be included to reflect the real situation.

Outcomes of the models for analyzing the equilibrium in transport were the identification of the level of demand which produces the lowest virtual transport costs for each mode of transport and can be used in economic value impact evaluation. The economic effect of non-equilibrium in infrastructure utilization can be measured on the assumption that the effect is the opportunity cost that could be saved if equilibrium were to be achieved. The economic loss, then, is the difference between the current total cost of and the total cost of transport in equilibrium conditions as shown in the equation below.

Economic loss	=	Total cost of current utilization of Infrastructure, less
		Total cost of balance utilization of infrastructure

Equilibrium Analysis Model for Passenger Transport

For passenger transport, human behavior differs for each transport purpose (such as travel to work, study or touring). This is a key factor affecting the selection of transport mode. Ideally, therefore, passenger transport equilibrium should be analyzed for each trip purpose.

However, in order to perform individual trip purpose analysis, the collected data must be very extensive and highly accurate. In-depth surveyed data are required and wide coverage interviewing is needed. At present, the available cost data and passenger flow information is not adequate for this purpose. Consequently, the passenger transport equilibrium analysis should be analyzed between provinces.

Bearing this in mind, a standard equation below is used to estimate the proportion of passengers, traveling by each mode, which minimizes the total national costs;

$$\boxed{f(x) = a_1 b_1 x_1 + a_2 b_2 x_2 + ... + a_n b_n x_n}$$

where f(x) = Total cost of all modes of passenger transport between Provinces,

x_n = Volume of passenger trip of each mode of transport,

a_n = Total cost per unit of passenger transport by mode n,

b_n = Coefficient of constraint in passenger transport mode n, and

n = Modes of transport, ie. by road, rail, water and air.

From the above equation, it can be seen that the total cost f(x) is not the actual cost of transporting type "x" passengers. In fact it is the 'virtual' total transport cost weighed by the limitation factors of each mode. The virtual costs thereby are reflective of the non-quantifiable monetary variables which improve the accuracy of the passenger transport equilibrium analysis.

From the above equation, the proportion of total passengers traveling by each mode was obtained in this study from available passenger flow data.

$$\boxed{X = x_1 + x_2 + \ldots + x_n}$$

where X = Total passenger trips

x_n = Passenger trips by mode n

The total cost, a_n, per unit of passenger transport by mode n can be obtained from the transport cost model.

The coefficient b_n reflects the level of attractiveness of each mode of transport and cannot be valued directly. This can be considered as a constraint level associated with each mode of transport.

The factors affecting the b_n coefficient, considered in this study, are those of:

- travel time of trip or (b_{1n}),
- convenience of utilization (b_{2n}),
- limitation of transport route (b_{3n}), and
- limitation on service provided (b_{4n}).

By way of example, in the analysis of travel from Bangkok to Chonburi province each mode will have similar transport cost equations but will have different adjusting factors (b_n) reflecting individual mode limitations. Accordingly, research to develop adjusting factors to reflect passenger behavior and attitude for each trip purpose needs to be conducted in detail.

The Example of Calculation of Coefficient "b" is as follows:

Example of "b" coefficient calculation

The case of passenger road transport between Bangkok and Chonburi

b1 = 0.5 (average travel time by road / average travel time by rail (slowest mode))
b2 = 0.1 (as route between Bangkok and Chonburi has good accessibility)
b3 = 0.5 (as quality of road infrastructure between Bangkok and Chonburi is high)
b4 = 0.5 (as quality of service for road passenger transport between Bangkok and Chonburi is high)

Thus, "b" coefficient for passenger road transport between Bangkok and Chonburi would equal to (b1xb2xb3xb4) = (0.5x0.1x0.5x0.5) = 0.125.

This "b" coefficient will be taken as "b_{road}" when being used in the equilibrium model for the case of passenger road transport between Bangkok and Chonburi.

Equilibrium Analysis Model for Commodity Transport

Since each commodity has its own supply chain pattern, analysis should be made by each individual commodity. Macro analysis of the transport of all commodities can be carried out once the construction of database of transport demand and supply chains for all individual commodities were completed.

The equilibrium between demand and supply of transport that minimizes the cost for a commodity type can be summarized in the following equation.

$$\boxed{g(y) = a_1b_1y_1 + a_2b_2y_2 + \ldots + a_nb_ny_n}$$

where $g(y)$ = Total cost of transport of commodity y by all modes of transport,

y_n = Transported volume of commodity y,

a_n = Unit cost for transport of commodity y by mode of transport n,

b_n = Coefficient of constraint of transport mode n for commodity y, and

n = Modes of transport, i.e. by road, rail, water, air, and pipeline.

The volume of transport of each commodity can be obtained from the database of transport flow showing current and forecasted ratios of each mode of transport where $y_1 + y_2 + \ldots + y_n$ must be equal to the total volume of transport of the commodity.

$$\boxed{Y = y_1 + y_2 + \ldots + y_n}$$

Where Y = Total volume of transport of commodity y

The total cost per unit of transport of each commodity can be obtained from the cost model for each commodity. The total cost of transport for each commodity by each mode can also be obtained.

From the study of transport costs, the equation showing unit cost or value of "a" of each mode of transport can be classified in terms of commodity type and mode of transport.

Analysis of the limitations of infrastructure utilization or the value of "b" coefficient comprising time or speed of trip (b_{1n}), convenience of utilization (b_{2n}), limitation of transport route (b_{3n}) and limitation on service (b_{4n}) can be carried out by the same process as for passengers.

The Equilibrium of Analysis of the Freight Transport Proportion of each Mode

Table 2-1 shows the analysis of equilibrium freight transport proportion. It can be concluded that the transport proportion which creates infrastructure equilibrium between road, rail, waterway, air and pipeline should be changed from 86.80%, 1.68%, 9.64%, 0.01% and 1.87% to 49.79%, 13.80%, 34.34%, 0.01% and 2.06% respectively. If the transport proportion reached equilibrium, the total transport cost saved would be reduced by 53,119 million Baht (decreased from 207,687 million Baht to 154,568 million Baht), the amount which equals to the national economic loss from the current imbalance. The equilibrium analysis concept has also been applied when setting targets and cost indicators.

Table 2-1 The Result of the Freight Transport Equilibrium Analysis (2001)

		2004	2011
Proportion %	Road	86.80	49.79
	Rail	1.68	13.80
	Water	9.64	34.34
	Air	0.01	0.01
	Pipeline	1.87	2.06
Total Transport Cost (Million Baht)		**207,687**	**154,568**

The Guideline to Create Infrastructure Usage Equilibrium

This study has recommended 2 major guidelines for creating infrastructure usage equilibrium as follows:

1) Management Aspect

The government needs to restructure urgently the management of problematic rail modes by separating the physical infrastructure development responsibility (track, station signals) from passenger and freight transport service provision. It also needs to establish a regulatory role so as to create operational flexibility. In principle, the government should support rail transport to become self-financing as much as possible, increasing its competitiveness relative to the other modes.

2) Planning Aspect

MOT needs to improve its project planning process and budget management/administration to ensure their effective integration with the follow-up and assessment system.

MOT has set a public service target concerning equilibrium by stressing the need to achieve suitable transport infrastructure usage. Such modal shift would lead to equilibrium of infrastructure usage and also result in a reduction of national transport cost.

Therefore, a new MOT project planning guideline, that can be connected to the follow-up and assessment system, has been proposed, as shown in Figure 2-1.

Notably, the process can be applied to other public service targets as well. The process starts from government policy which leads to supporting development strategy and public service targets. Subsequently, the work will be divided in to two parallel parts.

- **Part 1** emphasizes the program planning to determine future projects and measures. The plan must be clearly consistent with the targets, leading to an effective implementation of the projects and measures.

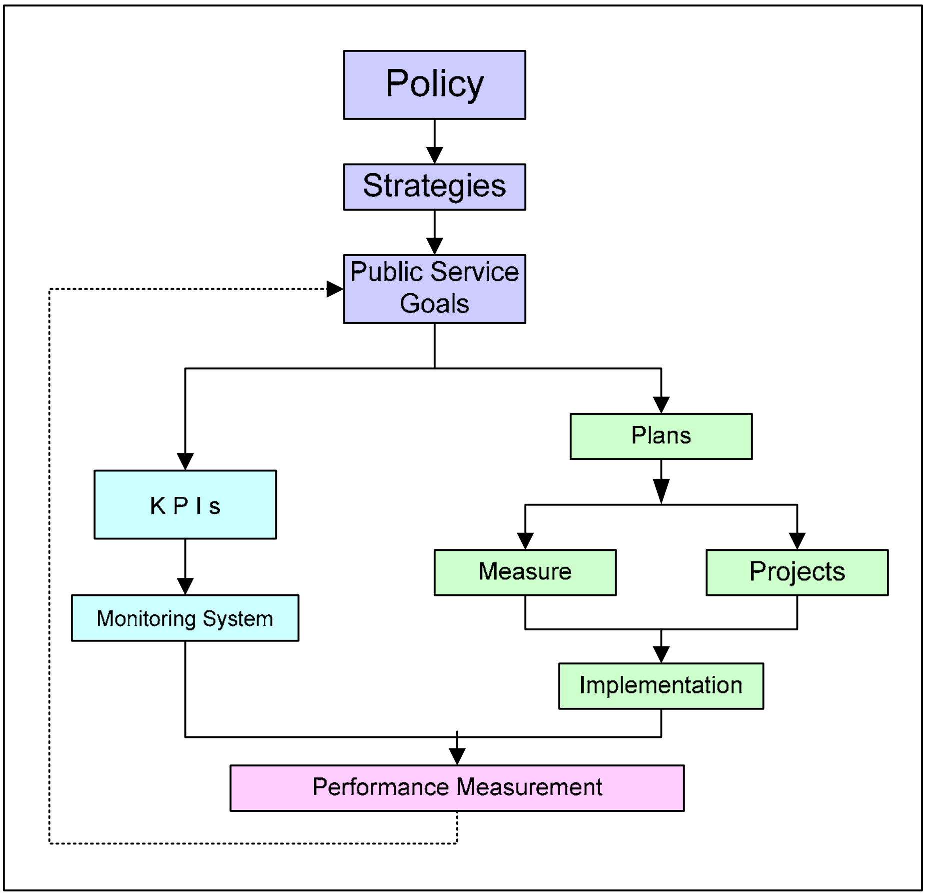

Figure 2-1 Integrated Project Planning Process Structure

- **Part 2** concentrates on the follow-up and outcome assessment of the plan including the determination of key performance indicators and implementation targets. It includes data collection which enables transparent evaluation. The evaluation result will be used as data improve service, program, project and other targets to improve the overall public service target.

The above broad framework brings about the equilibrium analysis and evaluation process as described in Figure 2-2.

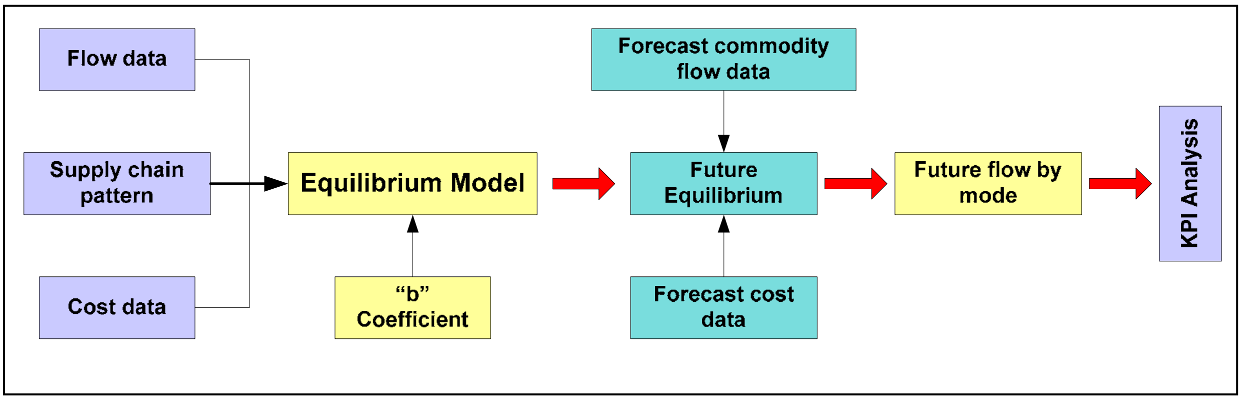

Figure 2-2 Infrastructure Usage Equilibrium Analysis Process Structure

3. Key Performance Indicators (KPIs) for Public Service Agreement and Monitoring Process for Achievement of KPIs

The objectives of this study are to determine KPIs for Public Service Agreement for MOT and also to recommend a monitoring process for achievement of KPIs.

3.1 Public Service Agreement and KPIs

Indicators are defined as KPIs. They are precise for each operation and operator, involving the monitoring and evaluation activities and highlight whether they are consistent with the specified objectives of the organization. They could also be used to supervise and/or evaluate an agent who is responsible for indicator issues.

According to the public service agreement defined by the MOT, there are six targets as shown below;

1) Reduction of transport costs;
2) Reduction of accident ratios in the transport and traffic sector;
3) Providing greater access to the public transport system for the general public and operators;
4) Providing the public more safety and convenience when using transport and traffic systems;
5) Obtaining equilibrium utilization of the transport infrastructure; and
6) Obtaining integration of transport infrastructure and services.

In this study, the public service targets of the MOT aimed at reducing transport costs, gaining equilibrium utilization of transport infrastructure and formulating integration of transport infrastructure and services, are analysed.

In order to determine the KPIs of the target, baseline data from the organizations related to MOT is essential. These include the transport information for commodities and passengers and interviews of operators, including the related organizations.

The target values derived below for 2011 are produced by application of the Traffic and Transport Model of OTP and the equilibrium equations. It is necessary to redefine these target values every year to reflect changing environmental constraints, strategies and dynamic frameworks. The result of proposed target and indicator calculations are as follows:

First Target : Reduction of Transport Costs

Indicators:

1.1) Unit cost of transport of commodities is reduced by 25%

1.2) Energy cost for transport of commodities is reduced by 25%

1.3) Energy cost for transport of passengers within Bangkok Metropolis is reduced by 10%

Second Target : Equilibrium Utilization of Transport Infrastructure

Indicators:

2.1) Ratio of road transport of passengers (60%)

2.2) Ratio of rail transport of passengers (35.5%)

2.3) Ratio of water transport of passengers (4%)

2.4) Ratio of air transport of passengers (0.5%)

2.5) Ratio of road transport of commodities (50%)

2.6) Ratio of rail transport of commodities (14%)

2.7) Ratio of water transport of commodities (34%)

2.8) Ratio of air transport of commodities (0.01%)

Note : There is also a ratio of 2% for pipeline transport, but, at present, the pipeline transport cannot be used as an indicator for the MOT.

Third Target : Integration of Transport Infrastructure and Services

Indicators:

3.1) Achievement of integrated programs and plans is 100%

3.2) Total capacity of public mass rapid transit is 5.5 million passengers/day

3.3) Total capacity of infrastructure for domestic transport of commodities is 285 million tons/year

3.4) Volume of passengers is 72% of public transport service capacity

3.5) Utilization of road for transport of commodities is 100% of its capacity

3.6) Volume of passengers is 82% of the capacity of MRT

3.7) Utilization of rail for transport of commodities is 60% of its capacity

3.8) Utilization of water infrastructure for transport of commodities is 70% of its capacity

3.9) Volume of passengers is 57% of the air capacity for passengers transport

3.10) Utilization of air infrastructure for transport of commodities is 46%

Once the public service targets and the indicators at the ministerial level have been clearly set, they will become the framework to be used by other agencies, under the authority of the Ministry, to set their own targets of outputs and indicators related to the allocated budget. It is assumed that achievements of the output targets at the agency level will also bring about achievement at the ministerial level.

The proposed integrated infrastructure usage KPIs are summarized in Table 3-1.

Table 3-1 Key Performance Indicators

Indicators	Base Year (2004)	Target	Yearly Target					
			2006	2007	2008	2009	2010	2011
1. Reduction of unit Cost on Freight Transport (percent)	-	25	2	5	8	13	19	25
2. Reduction of Energy Consumption Cost on Freight Transport (percent)	-	25	2	5	8	13	19	25
3. Reduction of Energy Consumption Cost on Passenger Transport in BKK (percent)	-	10	1	2	4	6	8	10
4. Proportion of Passenger Transport by Road (percent)	78	60	74	71	69	66	63	60
5. Proportion of Passenger Transport by Rail (percent)	15	35.5	21	24	27	30	32	35.5
6. Proportion of Passenger Transport by Water (percent)	5.5	4	5	4.8	4.6	4.4	4.2	4
7. Proportion of Passenger Transport by Air (percent)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
8. Proportion of Freight Transport by Road (percent)	88	50	84	80	74	68	59	50
9. Proportion of Freight Transport by Rail (percent)	1.7	14	2	3	6	8	11	14
10. Proportion of Freight Transport by Water (percent)	9.8	34	11	14	18	22	28	34
11. Proportion of Freight Transport by Air (percent)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
12. The Success of the Project Integration (percent)	-	100	100	100	100	100	100	100
13. Mass Transit Capacity to Accommodate Passenger (million persons/day)	4.5	5.5	5.3	5.3	5.4	5.4	5.5	5.5

Indicators	Base Year (2004)	Target	Yearly Target					
			2006	2007	2008	2009	2010	2011
14. Mass Transit Capacity to Accommodate Freight (million tons/year)	-	285	230	235	250	260	270	285
15. Passenger Volume against Road Transport Capacity (percent)	85	72	83	81	79	77	74	72
16. Usage Volume against Road Transport Capacity (percent)	98	100	100	100	100	100	100	100
17. Passenger Volume against Rail Transport Capacity (percent)	51	82	59	61	64	70	76	82
18. Usage Volume against Rail Transport Capacity (percent)	60	60	80	90	90	30*	50	60
19. Usage Volume against Water Transport Capacity (percent)	70	70	80	90	70*	80	90	70*
20. Passenger Volume against Air Transport Capacity (percent)	90	57	95	51*	53	55	56	57
21. Usage Volume against Air Transport Capacity (percent)	80	46	80	28*	32	37	42	46

Remark: * Changes in capacity due to new infrastructure projects

The year-end targets for each KPI in Table 3-1 are the changes relative to the KPI value in base year (2004).

Targets on transport cost cover KPI No.1-3, all of which were set to decrease from their base-year values. Equilibrium models are used to estimate the target value of KPI No.1 (Reduced total freight transport cost). Estimation of KPI Nos. 2 and 3, which are related to energy consumption within the total transport cost, are undertaken by using the target values from government policy.

Year-end targets are estimated by considering the effect of the projects to be implemented during the plan. These targets are set at relatively modest levels in the early stages of the plan (i.e. 2006–2008), as implementation of improvement measures will still be in progress. The targets for the latter stage of the plan (i.e. 2009–2011) are set at a relatively aggressive level as a number of improvement measures will have been in operation for approximately one year. The effect of implemented improvement measures should already be realized.

For example, plan-end target for KPI No. 1 (total freight transport cost) is to be decreased for 25 percent in 2011. The year-end targets should therefore be set at 2, 5, 8, 13, 19 and 25 for years 2006, 2007, 2008, 2009, 2010 and 2011 respectively, which follows the above principle. Nonetheless, these year-end targets need to be reviewed regularly, and modified if necessary, as there are uncertainties such as preparedness of the implementing agencies. The plan-end target, on the other hand, should be strictly followed.

Targets on equilibrium of transport infrastructure usage (transported mode) cover KPI No.4-11. These targets, shown in Table 3-1, illustrate the target percentage of modal split (between road, rail, water and air) for passenger and freight transport for plan-end as well as year-end within the plan. These figures are calculated from equilibrium models. As total transport cost is the main concern, 2011 targets show a decreasing portion of road transport, while the portion of rail and water transport are increasing, since road transport induces relatively higher cost.

Additionally, since these targets are relative values, they may be increased or decreased according to the proportional flow on each mode and total flow. The actual flow on each mode, which is an absolute value, will increase with growth in demand. For example, although the target modal split for road freight transport is set to decrease from 88 percent to 50 percent, actual flow may not be reduced. It may only be increased at a slower rate because road transport is the fundamental mode of transport which acts as the link between other modes. Reducing the percent share of road transport in this case implies that 38 percent of the total future flow will shift to rail and water transport.

Nevertheless, for water passenger transport, even though its unit cost tends to be relatively low, its percent share is set to drop, as a result of constraints on capacity and network expansion.

However, the percentage share of passenger and freight transport by air is set to remain stable because its user travel behavior is different from other modes.

For the targets concerning the provision of integrated transport infrastructure and services, these involve KPI No. 12 – 21. Target for KPI No. 12 is always 100 percent as this KPI measures progress of the implementation of planned projects. In other words, this target will be fulfilled if implementation is right according to the plan.

KPI No.13 and 14 compare future capacity of passenger and freight transport infrastructure respectively. These future capacity levels are used as target levels to which the government should aim in order to meet future demand. In practice, however, these targets were established only on the basis of future demand pattern, as data on actual existing capacity, particularly for freight transport, is inadequate at this stage.

KPI No.15-21 measure utilization of passenger and freight transport infrastructure. These KPIs are comparisons of future demand (flow) which normally increases over time, with future capacity. Targets for some years may be dropped due to completion between major transport infrastructure projects. These projects create additional capacity in the system and thereby results in a drop in utilization. For example, the year-end target for rail utilization is set to increase gradually during 2006 – 2008 as planned short-term projects and measures are implemented by the government. This target is then set to a lower level in 2009 to reflect the completion of major rail projects in 2008 which results in sharp increase in rail capacity, and hence a decrease in rail utilization. Similarly, completion of Suwarnnabhumi Airport, scheduled in 2005, results in a drop in air transport infrastructure utilization around 2006.

For practical and efficient application of the monitoring and evaluation system, the existing planning process needs to be improved. The recommended new planning process is shown in Figure 3-1.

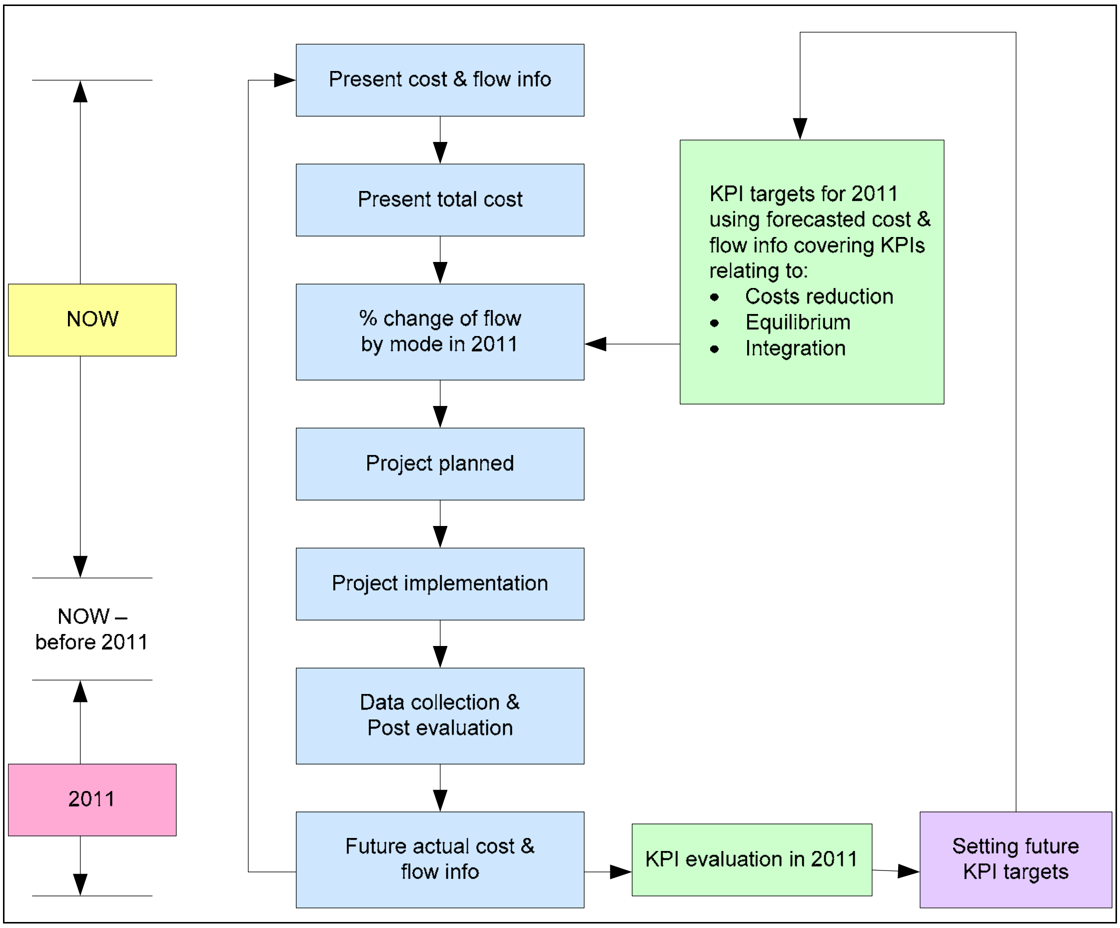

Figure 3-1 Steps in the New Planning Process

The work procedures in this part begin with analyzing the result of the indicator assessment in previous plans and the problems and obstacles which have caused deviations from targets, the transport cost data, observed freight and passenger flows. These are then used to form new targets for the new plans. The analysis and determination of indicator targets in accord with strategies and public service targets follows. The validation of any set of indicators' coincides with MOT's long-term strategic plans whereby short-term annual targets are needed to support the long-term plan. This is because the projects, programs, and other measures require a period longer than one year to bring about changes.

The planning of programs, projects, and other measures focus on implementation to reach the determined public service goals by selecting and prioritizing projects on a target serving basis.

The details of the planning steps related to follow-up and assessment can be categorized by time horizon. In this case, the long-term target has an equal horizon to that of the Ministry's strategic plan. The forecast situation in 2011 has to be made in order to derive the indicators' target. After that, the projects supporting the targets will be chosen and put into the plan. These projects should be completed within the year prior to the assessment of the long-term target so that evaluation of the projects' impacts on the overall transport system can be assessed.

In this case the final analysis and assessment of the indicators can be carried out in 2011 by using the actual observed data compared with the targets. The results will be used to analyze problems arising and will form future targets.

To ensure mutual understanding and clarity of the planning process suggested above, this study includes a case study of forming an integrated approach to transport and traffic development planning for freight transport so as to create equilibrium and minimize the cost of transport. The results are as follows:

Table 3-2 Proportion of Total Freight Transport in Equilibrium (2011)

	Proportion of Infrastructure Usage									
	Equilibrium Target					Present				
	Road	Rail	Water	Air	Pipeline	Road	Rail	Water	Air	Pipeline
Total Goods (%)	*49.79*	*13.80*	*34.34*	*0.01*	*2.06*	86.80	1.68	9.64	0.01	1.87

Remark: the numbers in italics are samples for calculator only

Table 3-3 Proportion of Total Passenger Transport in Equilibrium (2011)

	Proportion of Infrastructure Usage							
	Equilibrium Target				Present			
	Road	Rail	Water	Air	Road	Rail	Water	Air
Total Passengers (%)	*60*	*35.5*	*4*	*0.5*	78.3	15.6	5.6	0.5

Remark: the numbers in italics are samples for calculation only

In addition, the study has proposed programs and projects aiming to encourage modal shift to increase the usage and/or the service capacity in order to achieve the lowest total cost infrastructure system. These are compared with the target values of the indicators based on the infrastructure needs of both private and public sectors classified by areas. Furthermore, each project should be prioritized to reflect budget constraints for each stage of the plan.

In this study, the recommended projects for creation of equilibrium are selected from the Draft Strategy and Action Plan (Logistics Roadmap: 2005 – 2011) since these projects have been carefully discussed and planned by various departments under MOT.

However, the projects with an uncertain implementation schedule are removed. As a result, the number of the projects is 81 and the investment cost is estimated at 781,876 Million Baht as shown in Table 3-4.

Table 3-4 Proposed Investment Projects (2005-2011)

Item	Plan/Projects	Commencing Year	Completion Year	Budget
Road				71,110
1	Bangkok – Chonburi Motorway: Suwarnnabhumi – Chonburi Section	2005	2007	3,100
2	Chonburi Bypass Expansion	2005	2006	700
3	New Road linking Laem Chabang to #331 Highway	2003	2005	742
4	Leam Chabang Industrial Estate Interchange	2005	2006	200
5	#4052 Highway Section La Ngoo – Pakbara Port, Satul	2004	2006	75
6	Access Road to Multi-Purpose Port, Ranong	2005	2007	84
7	#1290 Highway: Mae Sai Bypass	2004	2006	218
8	Access Road linking Nakorn Phanom River Port	2005	2007	167
9	Road from #34 Highway to On-Nuch, Bang Plee	2005	2007	1,374

Item	Plan/Projects	Commencing Year	Completion Year	Budget
10	Road Connecting #34 Highway and #7 Highway (km 26)	2005	2007	413
11	Industrial Ring Road	2005	2007	8,793
12	Expressway: Bangna – Ajnarong Section	2003	2005	2,711
13	On-Nuch Access Road (Access C) to Suwarnnabhumi Airport	2004	2005	75
14	New Access Road linking Romklao Interchange and Suwarnnabhumi Airport (Access A&E)	2004	2006	1,900
15	King Kaeo Western Access Road (Access W) to Suwarnnabhumi Airport	2004	2005	151
16	#7 Motorway Expansion : Srinakarin – Suwarnnabhumi Airport Section	2004	2005	925
17	#34 Highway Improvement : Bang-Na – Suwarnnabhumi Airport Section	2004	2005	800
18	#3119 Highway: Lad Krabang – Minburi	2004	2005	420
19	#9 Motorway – Eastern Ringroad Thanyaburi – Bangplee Section	2005	2007	2,500
20	Suksawat – Bangplee Expressway	2005	2007	18,420
21	#331 Highway: #3 Highway Junction (Sattahip) – Laem Chabang Junction	2006	2007	1,150
22	Pattaya – Map Taphut Highway	2007	2009	4,100
23	#329 Highway: Supanburi – Pha Mok Section	2008	2009	600
24	#329 Highway: Pha Mok – Nakorn Luang Section	2006	2007	500
25	#329 Highway: Bang Pahun – Pachee Section	2007	2008	450
26	#329 Highway: Pachee – Hin Kong Section	2008	2009	400
27	#3063 Highway: #332 Highway Junction – Amphue Nakorn Luang	2007	2008	250

Item	Plan/Projects	Commencing Year	Completion Year	Budget
28	New Highway Linking Chonburi – Ban Bung (#34 Highway Junction-#344 Highway): 20 kms	2008	2009	800
29	Suwarnnabhumi Expressway Section 1 (M1-1)	2005	2010	15,536
30	Overpass Crossing Railways and Junctions (150 sites)	2005	2011	2,700
31	National Truck Route Network Identification	2006	2007	48
32	New Southern Bus Terminal	N/A	N/A	351
33	2nd Bus Terminal in Nakhon Sawan	2005	2006	42
34	Bus Terminal in Satun	2005	2006	25
35	Bus Terminal in Yala, Narathiwat, Pattanee	2005	2006	132
36	Bus Terminal in Trang	2006	2008	26
37	Integrated Bus Terminal in Mae Hong Sorn	2006	2009	22
38	Bus Terminal in Prachuap Khiri Khan	2007	2008	70
39	Bus Terminal in Chai Nat	2007	2008	70
40	Bus Terminal in Ang Thong	2007	2008	70
41	Expressway Linkage to High Speed Train - Makkasan/Asoke Station	2005	2007	N/A
Rail				**690,615**
42	Double Track: Chachoengsao-Sriracha-Laem Chabang	2004	2007	5,235
43	2nd ICD Construction (Lad Krabang Expansion)	2005	2008	6,066
44	Double Track: Kaeng Koy-Klong Sip Kao-Chachoengsoa	2005	2009	6,650
45	Track Rehabilitation Phases 4, 5 and 6	2005	2008	30,336
46	Bypass Tracks at Chachoengsoa, Kaeng Koy, Pachee Stations	2005	2008	998
47	Regional Container Yards	2004	2011	253
48	Sectional Double Track by Necessity	2005	2011	75,000
49	Intermodal Freight Linkage to 3 Railway Stations (Utaradit, Bang Pra, and Surat Thani)	2005	2005	n/a

Item	Plan/Projects	Commencing Year	Completion Year	Budget
50	Procurement of Train and Cargo Bogies	2005	2005	420
51	Improvement of Signaling and Communication System (according to Double Track Master Plan)	2005	2011	13,178
52	Hub and Spoke Intermodal Linkages in 3 Regions	2005	2008	30
53	Purple Line MRT System– (Bang Yai - Bang Sue Section)	2005	2009	46,704
54	Blue Line MRT System (Bang Sue – Tha Phra Section)	2005	2011	24,270
55	Blue Line MRT System (Hualamphong - Bang Kae Section)	2005	2012	48,692
56	Blue Line MRT System (Bang Sue – Ratburana Section)	2005	2012	63,744
57	Blue Line MRT System (Bang Krapi – Bang Bamru Section)	2005	2012	81,364
58	Red Line MRT System (Rangsit – Bang Sue Section)	2005	2009	28,474
59	Red Line MRT System (Bang Sue – Hualamphong – Makkasan Section)	2006	2009	17,601
60	Red Line MRT System (Bang Sue-Talingchan Section)	2006	2009	13,075
61	Red Line MRT System (Hualamphong Section – Mahachai Section)	2006	2009	39,356
62	Procurement of Trains for Red Line MRT System	2006	2009	34,080
63	Dark Green Line MRT System (Mochit – Sapanmai - Sapantak – Taksin Road – Petchakasem)	2005	2010	32,882
64	Light Green Line MRT System (On Nuch – Samut Prakhan and 1st Rama –Pinklao – Charansanitwong)	2005	2010	54,090
65	Airport Rail Link	2006	2010	68,117

Item	Plan/Projects	Commencing Year	Completion Year	Budget
Water				17,793
66	Private Participation in Construction, Management and Operation of Port (C1, C2, D1, D3 and A3)	2004	2007	Private Sector
67	Shore Port Development (AO)	2004	2006	196
68	Pak Bara Deep Sea Port Development	2005	2008	5,501
69	Deep Sea Port Development – Lower Thai Gulf	2005	2010	2,798
70	Multi-Purpose Port Development, Ranong	2004	2008	200
71	Intermodal Logistics Project: Thai Maritime Navigation's Coastal Ships + Express Transportation Organization' s Truck Fleet	2005	2008	5
72	Construction of Waterway Transport Stations for Energy Saving	2005	2010	859
73	Port Construction, Chum Porn	2005	2009	815
74	Water Rise Lock for Waterway Transport in Choa Phaya and Nan Rivers	2004	2012	6,028
75	Multi-Purpose Port Development, Don Sak, Surat Thani (Phase 1)	2004	2010	303
76	Lam Chabang Port Development Stage 3	2005	2006	110
77	Freight/Tourist Port Construction to Support Integrated Spatial Development Strategy	2003	2011	978
Air				2,358
78	Implementation of IT Support System for Suwarnnabhumi Airport	2005	2005	770
79	Development Project for Chiangmai Airport to be Regional Hub	2004	2006	1,289
80	Development Project for Phuket Airport to be Regional Hub	2004	2006	279
81	Construction of Aircraft Passenger Loading Bridge for Surat Thani Airport	2005	2005	20
	Total Budget			781,876

During project implementation, OTP and implementing agencies have to supervise and coordinate collectively to ensure the timely completion of the projects as well as the planned utilization. Nonetheless, the project outcomes or benefits must be achieved at least one year prior to the actual evaluation to ensure accuracy.

3.2 Monitoring Process for Achievement of KPIs

In this stage, OTP must observe the programs/projects outcomes in terms of the usage volume and/or changing infrastructure capacity and the new transport proportion on each mode. Such assessment has to be on an annual basis to compare the project outcomes with the annual target of the indicators. A detailed survey will be carried out in target year 2011 to evaluate the overall work outcomes.

The evaluation of indicators will be performed by comparing the project outcomes with the target indicators; assessing problems obstructing the achievement of expected results, and offering solutions. In addition, changing of modal proportion will further be used as input information for the planning process and setting of new target indicators.

The responsibilities in the monitoring process should be divided into 3 parts :

- Data Collector who follows up the work, collects and records needed data and presents to the inspector for checking,
- Data Inspector who checks and certifies the validity of data received and issues approval for using of data, and
- Monitoring Supervisor who monitors and reports the implementation of KPIs, directs and coordinates the work and reports the result of implementation to the executive.

The Data Inspector and Monitoring Supervisor may be the same person/organization, but the Data Collector and Data Inspector should not be the same person/organization.

In the monitoring process, the following forms should be used:

1) Details of KPI Form,
2) KPI Target Form,
3) Project Administration Form,
4) Implementation and Budget Spending Form (Reporting Form of the Bureau of the Budget), and
5) KPI Implementation Report Form.

The Project proposed the recommendations to administer the indicators in the process of monitoring:

- Process in sending relevant data to the appropriate responsible persons should be set under the control of the chief of the organization so that the data will be reported in proper time.

- The documents to be used in collecting of data should be standardized so that they can be used in every organization. The design of forms should be done by the top-down process.

- Targets should be set by considering past performance but emphasis should be given to gradual improvement as the resources and capacity of the organization are enhanced.

- The national benefit likely to be achieved should be explained before giving responsibility for specific KPIs to any organization.

- Factors affecting the work, such as economic change or investment trends in the private sector, should be considered.

- Indicators that have been identified and standardised may not require further development provided that the high ceiling capacity of the organization has been reached.

4. Development of Digital Databases and Models

The scope of work includes the procurement and installation of hardware and software of the defined operating system as shown in Figure 4-1:

The network which links the PC Server to the LAN network of OTP and Office of Permanent Secretary of MOT is shown in Figure 4-2.

The programs to be constructed are:

1) Database system and model for commodity flow;
2) Database system and model for passenger flow;
3) Database system and model for transport cost of commodities;
4) Database system and model for transport cost of passengers;
5) Program system for the KPI model, monitoring system; and
6) Master Data.

All the databases can be used for both the calculation and reporting processes. Reports can be shown on the monitors or can be printed out either in details or in summary format. The processed data can be used in the models and can also be linked to the MIS and GIS systems.

Data are composed of both primary and secondary data. The system of work includes data entry, data verification, calculation and processing, analyzing and reporting.

The designed model programs are flexible and can be updated, extended or reduced according to need.

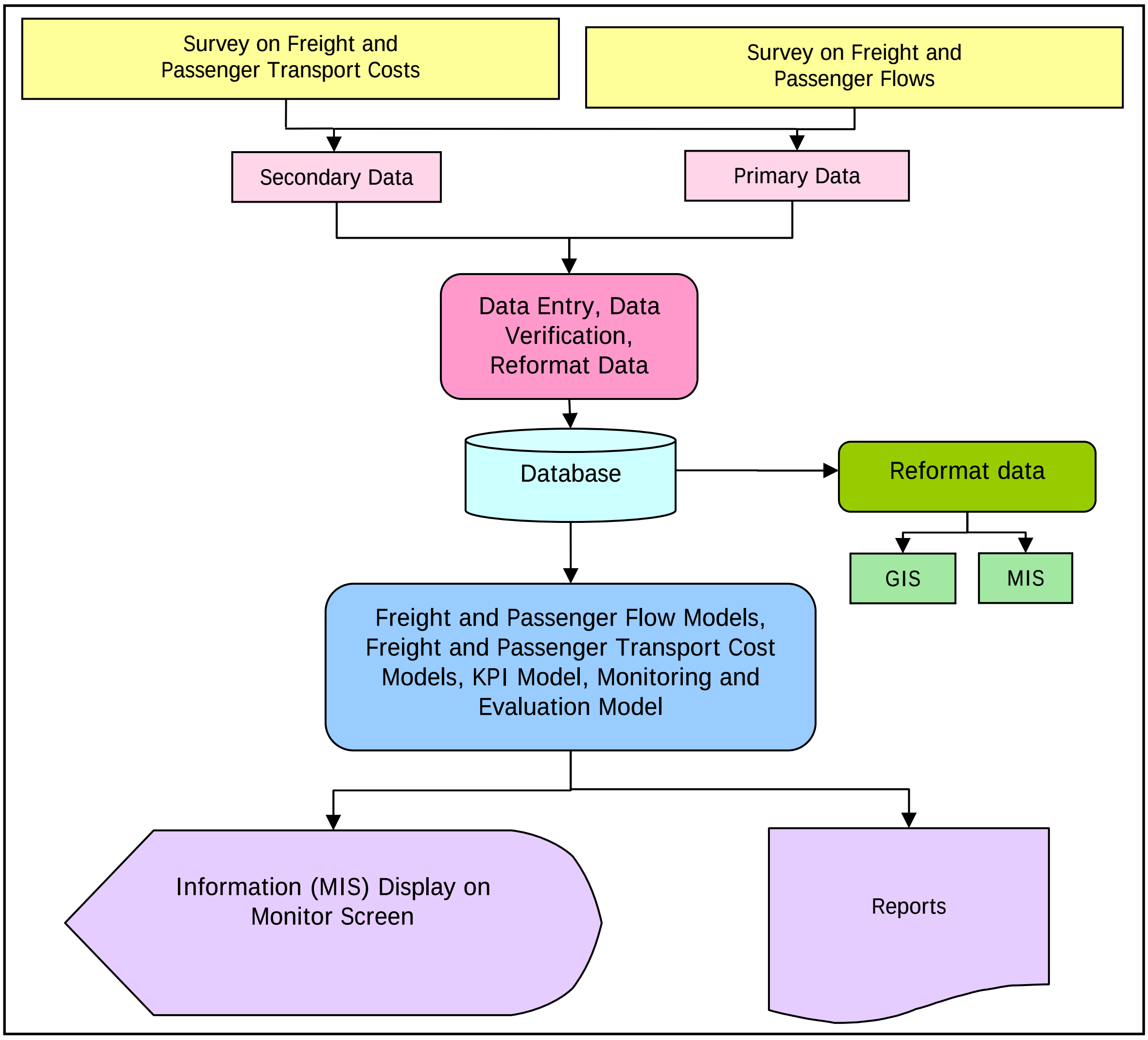

Figure 4-1 Database System and Model Work Flow

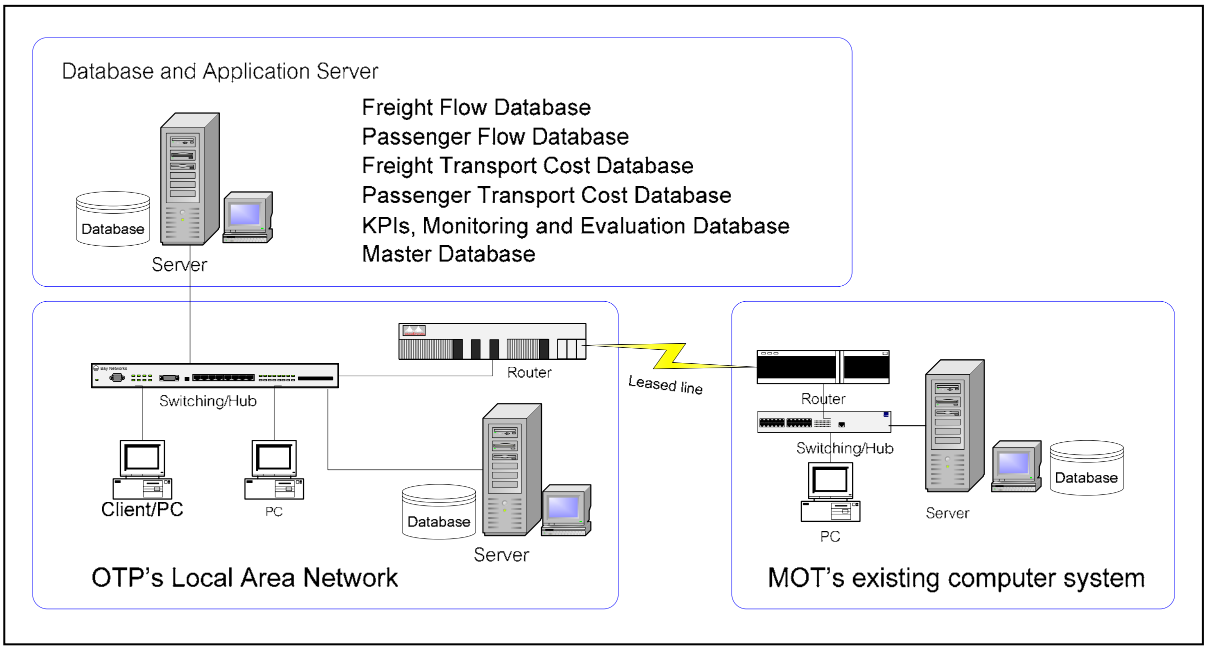

Figure 4-2 Computer Hardware and Network

With regard to the study, it could be suggested that:

- Officials should be designated and assigned to take care of and maintain the system so that it always works efficiently. Special care must be given to the PC Server and the databases because they contain all the valuable data. The security and data backup system should also be considered.

- Officials should also be designated and given responsibility on data collection and survey. They should also be responsible for updating of data in the databases.

5. Recommendations for the Improvement of the Transport and Traffic Planning Process

Concerning on short term guidelines for enhancing the transport and traffic planning capability of the MOT, it could be recommended that:

Development of Transport Flow Databases for Commodities and Passengers

A system should be set up which requires transport operators and related persons to record data on commodity and passenger flow, including to report them to the Central Data Center. This could be the OTP, for it to collate, analyze and make use of them for the benefit of the government. Data reporting should be done regularly but care should be taken to ensure the frequency of updating is not burden for the operators. Updating should however be at least once a year.

Development of Transport Cost Databases for Commodities and Passengers

The databases should be updated in accordance with changes which occur to the variables relating to costs. For some variables, updating should be carried out every year while other variables may need to be updated once in 3-5 years.

Cost data that should be updated every year are:

- Average price of fuel oil for HSD/Benzene91/Benzene95/Gas LPG/Jet A-1 (Baht/liter)
- Volume of petroleum transported through pipelines per year (million liters/year)
- Volume of passengers of each mode of transport (passengers/trip)
- Average trip length of vehicles (kilometers/day)
- Average number of trips/day of vehicles
- Annual budget for construction and maintenance of highways
- Annual expenses for infrastructure of railways
- Number of vehicles
- Volume of commodities and passengers transported by road, rail, water and air, per year (ton-km., passenger-km.)
- Annual budget for the transport and communication sector
- Number of injured persons, deaths, and the number of road accidents per year
- Monetary value of rail accidents per year, total annual income
- SRT income from transport of commodities per year and income from transport of passengers per year
- Ratio of budget allocated for the reduction of waterway accidents (%)

Cost data that should be updated every 3-5 years are:

- Loaded factor of vehicles on round trip (Load Factor - %)
- Loaded capacity by commodity type by vehicle type per trip (ton/trip)
- Ratio of fuel use of vehicles (km./liter)
- Ratio of fuel use of aircraft (liter/hour)
- Transport charges by commodity type (Baht/ton)
- Investment for the development of transport infrastructure of non-profit government enterprises, classified by activity cost
- Investment for development of transport infrastructure and income of government enterprises
- Opportunity cost of road accidents, classified according to death, severity of injury and damage of property per accident
- Air pollution cost and noise pollution cost (Baht/km)

Indicators Directly Relating to the Follow-up and Assessment of MOT Public Service Targets

These could be suggested as:

- Establishment of regular data transmission work procedures for those agencies in charge of assessing the indicators, under the supervision of the department head.

- Design of standardized documents and reports so that the data within which can be used by any department. The document should be designed by the top-down approach.

- The setting of service targets should include consideration of current capacity. However, emphasis should be given to continually raising targets based on the enhanced resources and department capacity.

- Overall benefits should be explained prior to assigning the indicators to each department. Furthermore, the factors which might impact the indicators, such as economic changes and private investment trends, should be taken into consideration.

In assessment, the measuring criteria on indicators must be clear in terms of target setting, cut off value and scoring.

Enhancing of Long Term Capability in Transport and Traffic Planning of MOT

For MOT to develop its planning process more effectively, it is required to the integrated overall strategic framework in terms of planning, regulating, providing infrastructure and servicing transport to ensure sustainable development.

The main objectives of the development include:

1) To improve the database and models concerned with transport costs, passenger and freight flows, as well as standardization of survey systems and data collection.

2) To develop the personnel of concerned departments in order to adapt them to the new planning system, to enhance their capability and to enable them to be recognized as capable by operating departments.

3) To restructure the organizations under MOT to achieve clear understanding of duties and responsibilities as well as to be compatible with the new work process.

The MOT capacity increasing program in integrated transport and traffic planning management should consist of various tasks as described in Figure 5-1.

The concept of the MOT capacity building program should cover 3 main aspects, namely Database and Model Development, Human Resource Development and Transport Sector Reform, which will eventually affect the successfulness of planning formulation and implementation, OTP should use this concept in budget preparation. The summarized detail of the 3 main developments are as follows.

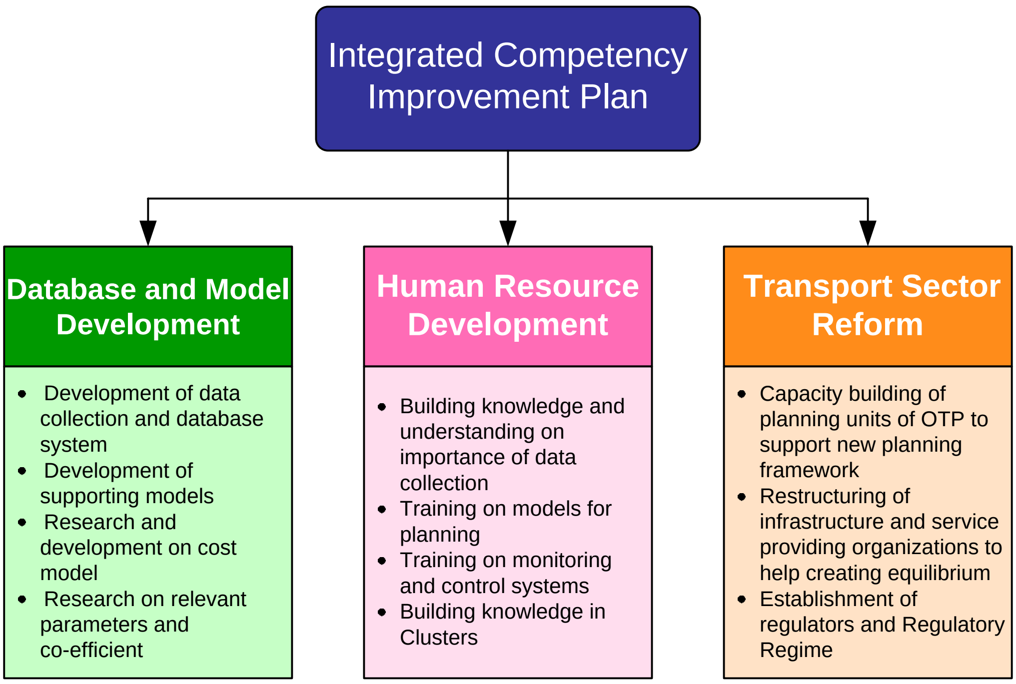

Figure 5-1 Structure of Drafted Integrated Transport and Traffic Planning Development

Development of Database and Model:

1) Data collection method should be developed to standardize survey and data collection. The data will be collected continuously, resulting in quality data for planning. OTP should conduct a study to establish standards and procedures for survey and data collection in order to ensure all organizations within MOT use the same standard.

2) Model development and model quality improvement are required. A detailed transport costing model, a passenger and freight transport flow model, an equilibrium model and an indicator analysis model are required to accommodate new planning, reflect the overall freight transport picture, and generate highly accurate outcomes projections. Consequently, OTP, as the central planning agency for transport sector, should study in further detail to refine the models developed in this study. Moreover, such models should be reviewed and updated every 2-3 years to keep up with the changing circumstances.

3) A research study on variables and other factors such as factor “b” to improve its appropriate values and consistent with realistic situation, would enhance the effectiveness of the models and the results of their application. This research should be continuous, for which consistent budget should be allocated.

Human Resource Development:

1) Development of understanding of survey and data collection systems. This is to enable MOT staff to comprehend the need for and requirements for data used for analyzing and planning, as well as knowledge of survey procedures when collecting data. This will enable MOT staff to provide academic support to operating departments collecting data for MOT.

2) Conducting training courses on the use of model for planning. Despite training on model application given towards the conclusion of this study, the training courses should be conducted regularly to transfer knowledge and experience to the next generation of staff.

3) Training on follow-up and assessment systems to create understanding of the system and the working process should be given to concerned personnel.

4) Development of knowledge of sectors important to the Thai economy, including the business sector and the mechanisms of important commodity sectors such as the rice, cane and sugar industries. This is to equip MOT staff with an understanding of business as well as the supply chain of industries and will be of great benefit in the planning process.

Transport Sector Reform:

1) Capacity building of planning units of OTP to support new planning framework. This is to create clarity of role and responsibility of all levels in the organization and to improve efficiency in planning, for which OTP has the key supporting role insofar as it is the central planning agency for MOT, as well as being the central monitoring and evaluation body which measures against the Ministry's public service targets. OTP needs to strengthen the capability of the organization as a whole, as well as its human resource, so that it can raise its bargaining power with external agencies (e.g. Budget Bureau, Ministry of Finance, NESDB, etc.). Consequently, OTP should conduct, as its first priority, a study to strengthen its capability in planning, monitoring and performance evaluation.

2) Restructuring of State owned Enterprises and government's operating agencies, which provide transport infrastructure and services, in order to help creating equilibrium of infrastructure utilization within the transport sector. As many of these existing organizations still have conflicting or overlapping roles and responsibilities, their roles of infrastructure provider, service provider and regulator should be clearly separated, either explicitly or implicitly. For example, the State Railway of Thailand is bearing all 3 roles, while Department of Highways only has a role of infrastructure provider. This has resulted in imbalance within the framework for management and resource allocation, as well as competition among modes, for the transport sector as a whole.

3) Improvement of the regulatory regime and regulator capacity. Although MOT has established the Department of Land Transport, the Marine Department and Department of Civil Aviation with the aim of establishing a fair regulatory system, their regulatory capacity still needs improvement. Additionally, some regulatory authority continues to rest with service providers such as Bangkok Mass Transit Authority (BMTA) and the Transport Company Limited. Often, regulatory regimes, in terms of rules and regulations, still lack clarity or have not yet been fully applied. These can be regarded as obstacles to development of the planning system.

Implementation Timeframe

Based on the above suggestions, in order to implement the new transport and traffic development planning efficiently, the MOT should follow the implementation timeframe as indicated in Figure 5-2.

Major Tasks	**Implementation Time Frame**					
	2006	2007	2008	2009	2010	2011
Database & Model Development						
1) Development of Survey and Data Collection Process						
2) Development of Models to support new planning system						
3) Research and developments on relevant parameters and coefficients						
Human Resource Development						
1) Training to create understanding on Survey and Data Collection						
2) Training on the use of Models in planning process						
3) Training on Monitoring and Evaluation Process						
4) Knowledge Management on business issues in Real Sector						
Transport Sector Reform						
1) Capacity building of planning units of OTP to support new planning framework						
2) Restructuring of infrastructure and service providing organizations to help creating equilibrium						
3) Establishment of Regulators and Regulatory Regimes						

Figure 5-2 Implementation Timeframe according to Drafted Integrated Development Planning

Appendix

Transport Cost Models for Commodities

1) Total cost of transport by road of agricultural commodity by 10-wheel truck

   = operator cost + government cost + external cost

   = [0.67692df+3.146d+7215.79]/[wd x load factor] Baht/ton-km.

   where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter

2) Total cost of transport by road of agricultural commodity by semi-trailer (18 wheels)

   = operator cost + government cost + external cost

   = [0.88df+3.146d+12023.92]/[wd x load factor] Baht/ton-km.

   where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter

3) Total cost of transport by waterway of agricultural commodity by river tugboat

   = operator cost + government cost + external cost

   = [7.355fh+32.436w]/[wd x load factor]+27.589/[d x load factor]+0.2774/[w x load factor] Baht/ton-km.

   whered is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter, h is operating hour.

4) Total cost of transport by road of manufacturing commodity by 4-wheel truck

   = operator cost + government cost + external cost

   = [0.26666df+5.8343d+3144]/[wd x load factor] Baht/ton-km.

   where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter

5) Total cost of transport by road of manufacturing commodity by 6-wheel truck

   = operator cost + government cost + external cost

   = [0.43637df+9.7799d+5041]/[wd x load factor] Baht/ton-km.

   where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter

6) Total cost of transport by road of manufacturing commodity by semi-trailer (18 wheels)

= operator cost + government cost + external cost

= [0.80000df+34.3508d+7196]/[wd x load factor] Baht/ton-km.

where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter

7) Total cost for transport by road of manufacturing commodity by 10-wheel truck (refrigerated)

= operator cost + government cost + external cost

= [0.53333df+21.0740d+4985]/[wd x load factor] Baht/ton-km.

where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter

8) Total cost of transport by rail of manufacturing commodity

= operator cost + government cost + external cost

= [4.906df+0.606wd+0.037d]/[wd x load factor]+0.1749] Baht/ton-km.

where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter

9) Total cost or transport by road of construction materials by semi-trailer (18 wheels)

= operator cost + government cost + external cost

= [0.80000df+6.9260d+7450.83]/[wd x load factor] Baht/ton-km.

where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter

10) Total cost of transport by rail of construction materials

= operator cost + government cost + external cost

= [4.278df+0.824wd+0.037d]/[wd x load factor] +0.2569 Baht/ton-km.

where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter

11) Total cost of transport by waterway of construction materials by river tugboat

= operator cost + government cost + external cost

= [30.649fh+54.960w]/[wd x load factor]+27.589/(d x load factor)+0.2774/(w x load factor) Baht/ton-km.

where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter, h is operating hour

12) Total cost of transport by road of petroleum by semi-trailer (18 wheels)

= operator cost + government cost + external cost

= [0.60000df+7.226d+9333.86]/[wd x load factor] Baht/ton-km.

where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter

13) Total cost of transport by rail of petroleum

= operator cost + government cost + external cost

= [4.287df+0.629wd+0.037d]/[wd x load factor]+0.2349 Baht/ton-km.

where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter

14) Total cost of transport by coastal freighter of petroleum by tank carrier

= operator cost + government cost + external cost

= [25.918fh+30101.93+0.00698v]/[wd x load factor]+27.589/[d x load factor]+0.2774/[w x load factor] Baht/ton-km.

where d is length in kms., v is volume of petroleum transport in liter, w is loaded weight in tons, f is fuel price in Baht/liter, h is operating hour

15) Total cost of transport by pipeline of petroleum

= operator cost

= [0.0057+2206/V] x [1016/0.83]/d Baht/ton-km

where d is length in kms., V is volume of petroleum transported not exceed 26,000 million liters/year.

16) Total cost of transport by air of agricultural/manufacturing commodity by leased aircraft, excluding of fuel

= operator cost + government cost + external cost

= [5.1857rfh+317.38w]/[wd x load factor] Baht/ton-km.

where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter

r is ratio of fuel used in liter/hour, flying length per trip h hour

17) Total cost of transport by air of agricultural/manufacturing commodity by leased aircraft, including of fuel and pilot

= operator cost + government cost + external cost

= [7.18571rfh+317.38w]/[wdload factor] Baht/ton-km.

where d is length in kms., w is loaded weight in tons, f is fuel price in Baht/liter

r is ratio of fuel used in liter/hour, flying length per trip h hour

Transport Cost Models for Passengers

1) Total cost of transporting passengers by road by BMTA bus (ordinary)

= operator cost + government cost + external cost

= [0.440dfm+4133.00]/[nmd]+ 4561/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

2) Total cost of transporting passengers by road by BMTA bus (air-conditioned, Euro II)

= operator cost + government cost + external cost

= [0.540dfm+8625.00]/[nmd] + 4561/nd + 0.715/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

3) Total cost of transporting passengers by road by private bus (ordinary)

= operator cost + government cost + external cost

= [0.478dfm+2024.69]/[nmd] + 4561/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

4) Total cost of transporting passengers by road by private bus (air-conditioned)

= operator cost + government cost + external cost

= [0.450dfm+2328.00]/[nmd] + 4561/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

5) Total cost of transporting passengers by road by minibus

= operator cost + government cost + external cost

= [0.245dfm+1393.19]/[nmd] + 2784/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

6) Total cost of transporting passengers by road by vanbus

= operator cost + government cost + external cost

= [0.140dfm+533.00]/[nmd] + 2784/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

7) Total cost of transporting passengers by road by Category IV bus

= operator cost + government cost + external cost

= [0.215dfm+257.99]/[nmd] + 2784/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

8) Total cost of transporting passengers by road by microbus

= operator cost + government cost + external cost

= [0.320dfm+2040.70]/[nmd] + 4561/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

9) Total cost of transporting passengers by road by taxi

= operator cost + government cost + external cost

= [0.135dfm+571.58]/[nmd] + 2784/nd + 0.937/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

10) Total cost of transporting passengers by road by Category II bus, Standard 1 A (24 seats)

= operator cost + government cost + external cost

= [0.350dfm+5188.00]/[nmd] + 4561/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

11) Total cost of transporting passengers by road by Category II bus, Standard 1 B Special (32 seats)

= operator cost + government cost + external cost

= [0.360dfm+6472.00]/[nmd] + 4561/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

12) Total cost of transporting passengers by road by Category II bus, Standard 1 B (40 seats)

= operator cost + government cost + external cost

= [0.280dfm+2759.00]/[nmd] + 4561/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

13) Total cost of transporting passengers by road by Category II bus, Standard 2

= operator cost + government cost + external cost

= [0.500dfm+3083.00]/[nmd] + 4561/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

14) Total cost of transporting passengers by road by Category III bus, Standard 1 B

= operator cost + government cost + external cost

= [0.580dfm+2624.53]/[nmd] + 4561/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

15) Total cost of transporting passengers by road by Category III bus, Standard 3

= operator cost + government cost + external cost

= [0.291dfm+909.41]/[nmd] + 4561/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

16) Total cost of transporting passengers by road by Category IV bus (outside Bangkok)

= operator cost + government cost + external cost

= [0.289dfm+657.92]/[nmd] + 2784/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

17) Total cost of transporting passengers by road by 6 wheel tourist bus in town

= operator cost + government cost + external cost

= [0.800dfm+1998.39]/[nmd] + 4561/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

18) Total cost of transporting passengers by road by 6 wheel tourist bus within the range of 300 kms.

= operator cost + government cost + external cost

= [0.800dfm+2198.39]/[nmd] + 4561/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

19) Total cost of transporting passengers by road by 6 wheel tourist bus with the range of more than 300 kms.

= operator cost + government cost + external cost

= [0.800dfm+2298.39]/[nmd] + 4561/nd + 3.135/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

20) Total cost of transporting passengers by rail by urban rail

= operator cost + government cost + external cost

= [4.151df+0.369nd]/[nd]+0.1817 + 0.037/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

21) Total cost of transporting passengers by rail by BTS

= operator cost + external cost

= 18499/[nd]+ 0.0155/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

22) Total cost of transporting passengers by waterway by ordinary express ferry in the Chao Phraya River

= operator cost + government cost + external cost

= [1.539dfm+4496.42]/[nmd]+ 5.646/d + 0.2774/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

23) Total cost of transporting passengers by waterway by yellow-flag express ferry in the Chao Phraya River

= operator cost + government cost + external cost

= [3.878dfm+3018.44]/[nmd]+ 5.646/d + 0.2774/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

24) Total cost of transporting passengers by waterway by express ferry in Klong Saen Saeb

= operator cost + government cost + external cost

= [2.710df+330.28]/[nd]+ 5.646/d + 0.2774/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

25) Total cost of transporting passengers by waterway by cross-river ferry

= operator cost + government cost + external cost

= [4.580dfm+1983.00]/[nmd] + 5.646/d + 0.2774/n Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, m is number of trips/day.

26) Total cost of transporting passengers by domestic air by second-hand aircraft

= operator cost + government cost + external cost

= [5.33301rfh]/[nd] + 27.69/d + 0.086 Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, r is ratio of fuel used in liter/hour, flying time per trip h hour

27) Total cost of transporting passengers by domestic air by new purchased aircraft

= operator cost + government cost + external cost

= [7.69256rfh]/[nd] + 27.69/d + 0.086 Baht/passenger-km.

where d is length in kms., f is fuel price in Baht/liter, n is number of passengers/trip, r is ratio of fuel used in liter/hour, flying time per trip h hour