

CHAPTER 3 Transportation and Traffic Model Improvements and Maintenances

- Review of the transport model developments
 - The National Model (NAM)
 - Extended Bangkok Urban Model (eBUM)
 - Simulation Model Development
 - Model Integration between NAM and eBUM
-

3.1 Review of the transport model developments

To complete the development of the transport model, the consultant has reviewed a series of steps in developing the existing transport model at detailed levels and assessed its efficiency coincidentally in order to lay an appropriate approach in developing and maintaining the transport model and also to give suggestions and recommendations in developing transport model structure. Figure 3.1 shows a series of steps in developing the transport model. The details of each process are:

- Efficiency Assessment, Laying the appropriate plans and principle in developing and maintaining the transport model

The consultant has reviewed the existing OTP transport model divided into three levels, i.e. The National Model (NAM), The extended Bangkok Urban Model (eBUM), and The Local Area Model (LAM).

The way to review the existing transport model at two levels can be explained in three steps namely:

- Reviewing the transport model application process;
- Review inputs, and
- Review parameters and mathematic relationship.

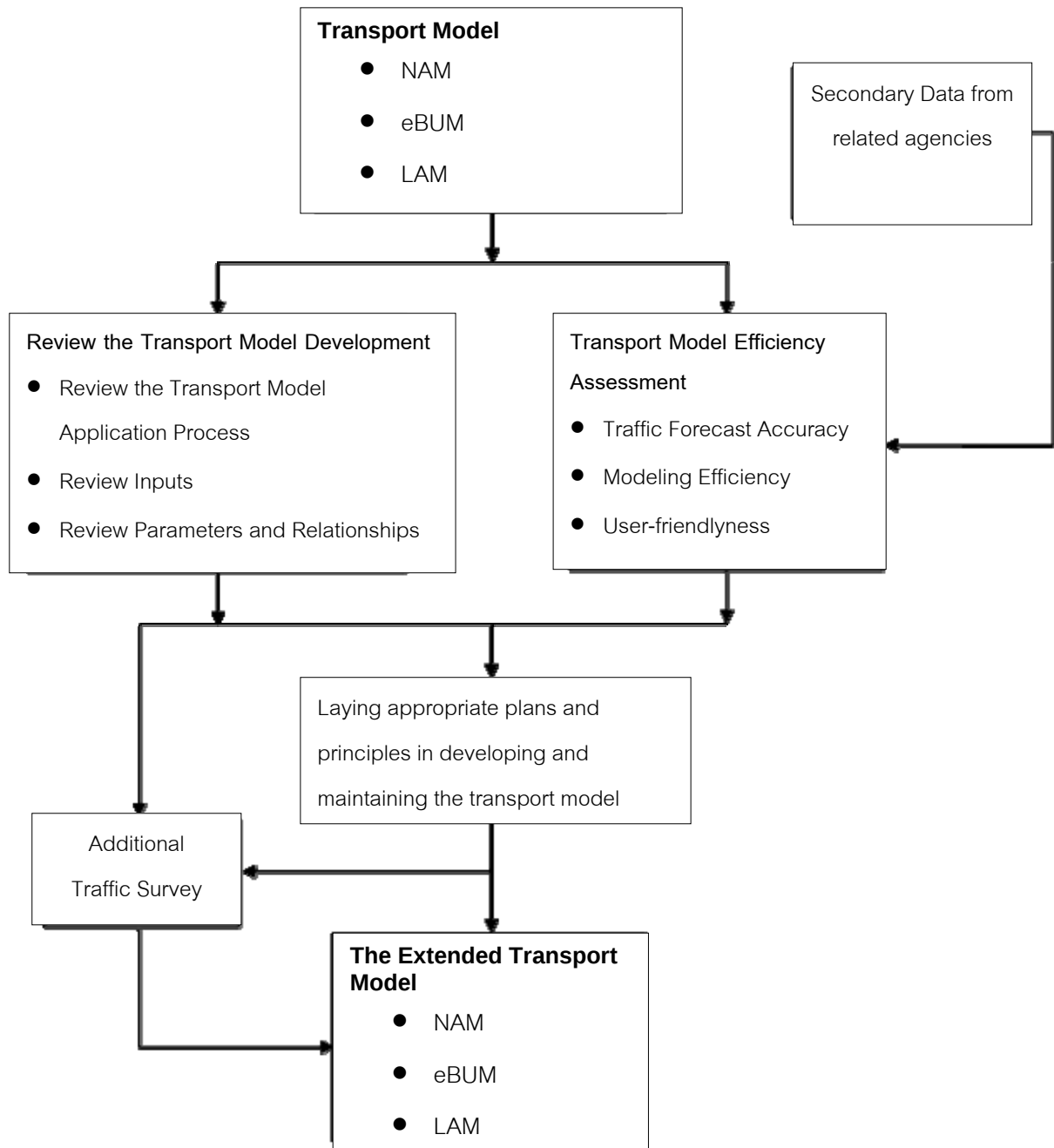


Figure 3.1 Transport Model Development and Maintenance Process

3.1.1 Review of Transport Model Application Processes

The consultant has thoroughly reviewed the application process of the existing transport model at all two levels.

Furthermore, the consultant has linked the transport model all levels together by which the outputs from the transport model at higher level can be used as boundary data for the transport

model at lower level, for instance, the total number of trips traveling from/into BMR from the eBUM can be obtained from the NAM, as a consequence of an increase in the efficiency of the transport model at any analysis level. Moreover, reviewing the transport model application process has provided useful data in laying the appropriate approach in developing and maintaining the future transport model.

3.1.2 Reviews of Inputs

The consultant has verified the accuracy of the coded input data used in the transport model at all two levels. With respect to traffic data such as traffic demand or socioeconomic data, the consultant has gathered the existing useful data together with the additional data from surveys and properly adapted them as a result of the most realistic final input data to produce reliable outputs.

In the previous versions of the transport model, input data at each level of the transport model were coded separately but input data (such as traffic demand network) at all levels of the transport model in the enhanced transport model has been gathered to a single database, as a result of time saving and the reduction of errors in editing input data.

3.1.3 Reviews of Parameters and Mathematical Relationships

The transport model developed by OTP comprises many mathematical equations in which each equation may consist of many parameters reflecting traveler behavior and network service characteristics. The consultant has revised and adapted parameters at two levels of the transport model to be more realistic and also reviewed the rationality of mathematical equations in the transport model in order to enhance the transport model as a consequence of more reliable outputs from the model.

The consultant has laid the principles to assess the transport model efficiency at two levels by which data for assessing the transport model has been gathered from properly related agencies. The principles consist of:

- Traffic Forecast Accuracy;
- Model Run Efficiency, and
- User-friendliness.

For the reason that the rate of socioeconomic change for Thailand has been so fluctuated over the years especially in BMR, the transport model needs a consistency with such the rate that

may affect traffic forecast of the transport model by which the consultant has set the detailed approach in maintenance and development with respect to the modeling process and inputs (which portion of them needs to be maintained/developed once more and when is the appropriate time?). In addition, the manual explaining a series of steps in the transport model application for a specific task test in the future has been conducted.

Additionally, to set the detailed approach in maintenance and development, data from reviewing the transport model and assessing the model efficiency have been used as well. The advantages of the transport model after maintenance and development are as follows:

- Better user interface;
- Data such as model structure characteristics at each level are all in one single database as a result of the more efficacious transport model;
- Accurate modeled outputs, and
- Better connectivity between the transport model at levels.

Besides, the consultant has developed NAM for daily assignment and eBUM for AM peak, PM peak and daily assignment during the base year 2007 and the project year 2012, 2017, 2022, 2027 and 2032.

3.2 The National Transport Model (NAM)

The consultant has gathered and reviewed planning data (such as population, GDP, traffic counts, network and so on) from previous study projects particularly from TDMC II, TDMC III, TDMC IV, and TDMC V projects and also updated and adjusted those data properly as a consequence of more accurate outputs from the transport model. The maintenance and development process of NAM is explained as follows.

3.2.1 Network and Transport Service Update

The consultant has updated the transport network for all transport modes including transport services by reviewing the existing database and then appropriately updated them from the obtained data. The transport network consists of passenger network and freight network. The data needed for updating the transport network are both primary and secondary. The primary data from OTP and related agencies are as outlined below:

- In course of travel

- Attitudinal survey
- Vehicle count
- Passenger count
- Trip rate
- Travel time/delay

The secondary data from both OTP and related agencies are as follows:

- Socioeconomic
- Land use
- Freight volume
- Fixed infrastructure
- Vehicle inventory
- Schedule of services
- Environment
- Transport economics
- Road accidents
- Tourist
- Traffic and Transport at regional city
- Programs and projects

Furthermore, data from related agencies such as Ministry of Transport or Nation Economic and Social Development Board have been obtained in order to review all project plans relating to the transport network, services and other useful aspects of the transport model.

3.2.2 The National Model (NAM) Improvement

TDMC V project has subdivided Thailand into 926 zones, according to Amphur boundary, including 11 external zones from adjacent counties accounting for 937 zones altogether. The consultant has gathered planning data and updated highway network among Amphurs in order to increase the accuracy of highway network in the transport model. Also, the consultant has developed the national model for the daily assignment during two periods of time. The first period is the base year 2007 and the second period is the project years consisting of the year 2012, 2017, 2022, 2027 and 2032.

This project has improved the road network by comparing with GIS data from Ministry of Transport. Example is shown in Figure 3.2

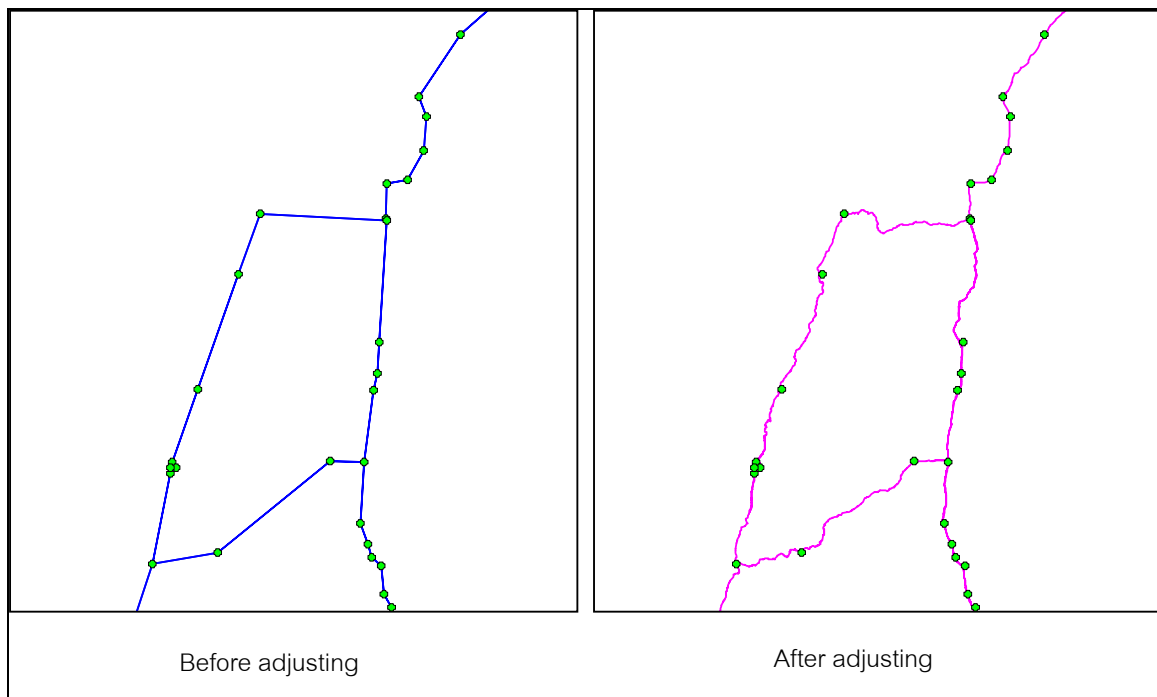


Figure 3.2 Road Network Before and After Adjusting

Moreover, after comparing the GIS data from Ministry of Transport with the GIS data from Department of Highways, it is noticed that their GIS data have some differences, as shown in Figure 3.3.

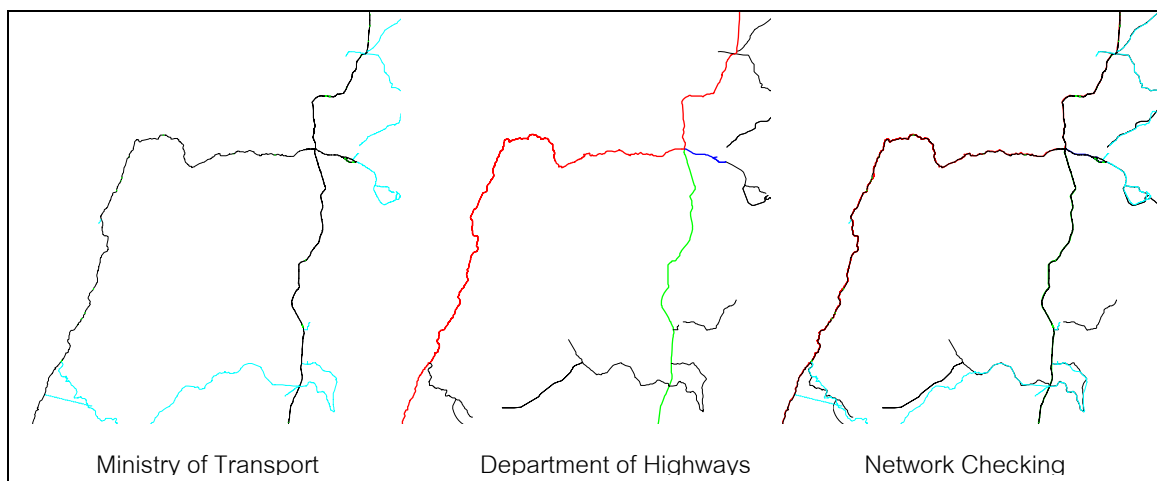


Figure 3.3 Comparison of GIS Data

Moreover, traffic assignment model was improved in this project, especially the person trip. The freight transportation was also improved in order to support the capability of Cube Cargo which

had been done in TDMC V together with the improvement of coordination of both parts by adding 13 types of freight. Additionally, VOC in the model have been changed the unit from baht per vehicle to baht per pcu by using weighting method from the statistics of vehicle travel (veh-km) (Department of Highways).

3.2.3 NAM Model Validation

The consultant utilized traffic volume from 4 screenlines to validate NAM stability. The processes of model validation are summarized in Figure 3.4. These screenlines are presented in Figure 3.5. and the results of NAM validation are summarized in Figure 3.6 - 3.8. Furthermore, results from NAM model development and improvement can be summarized as shown in Table 3.1-3.2. From the summary tables, the results found that both person trips and freight transportation are increasing to 9.89 million-trips/day and 6.94 million-tons/day in year 2032 from 2.60 million-trips/day and 1.60 million-tons/day in present (year 2007) respectively. Hence, there could be summarized that, in year 2032, the number of both person trips and freight transportation will be increased about 5% and 6% per annum respectively.

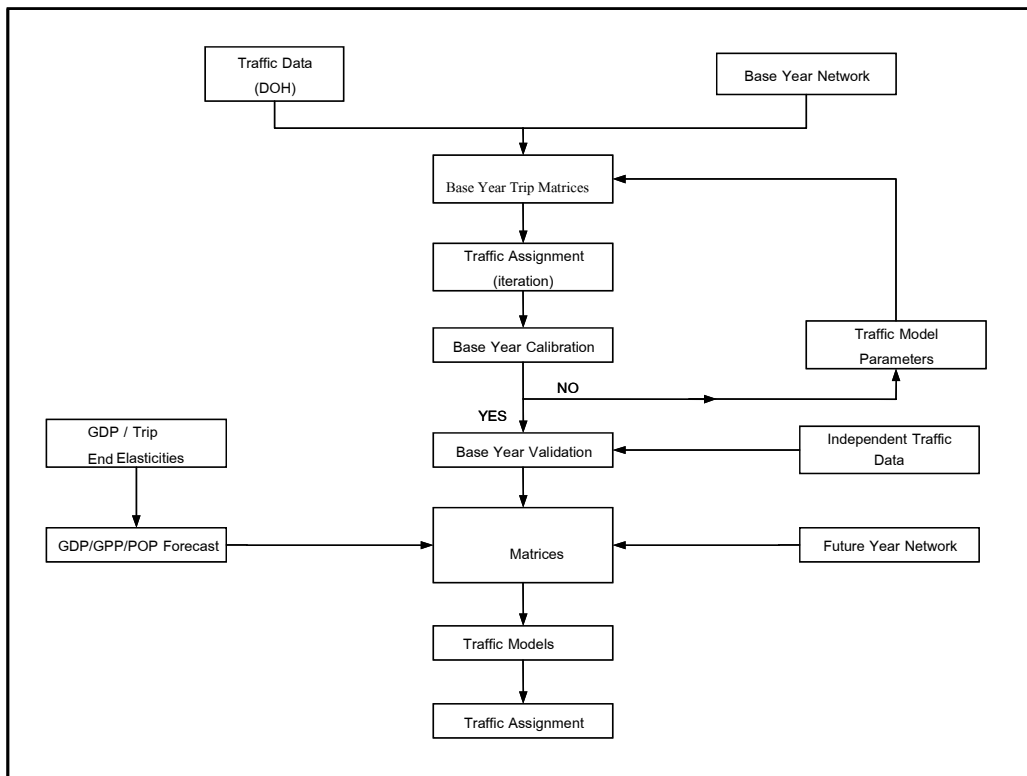


Figure 3.4 NAM model validation processes

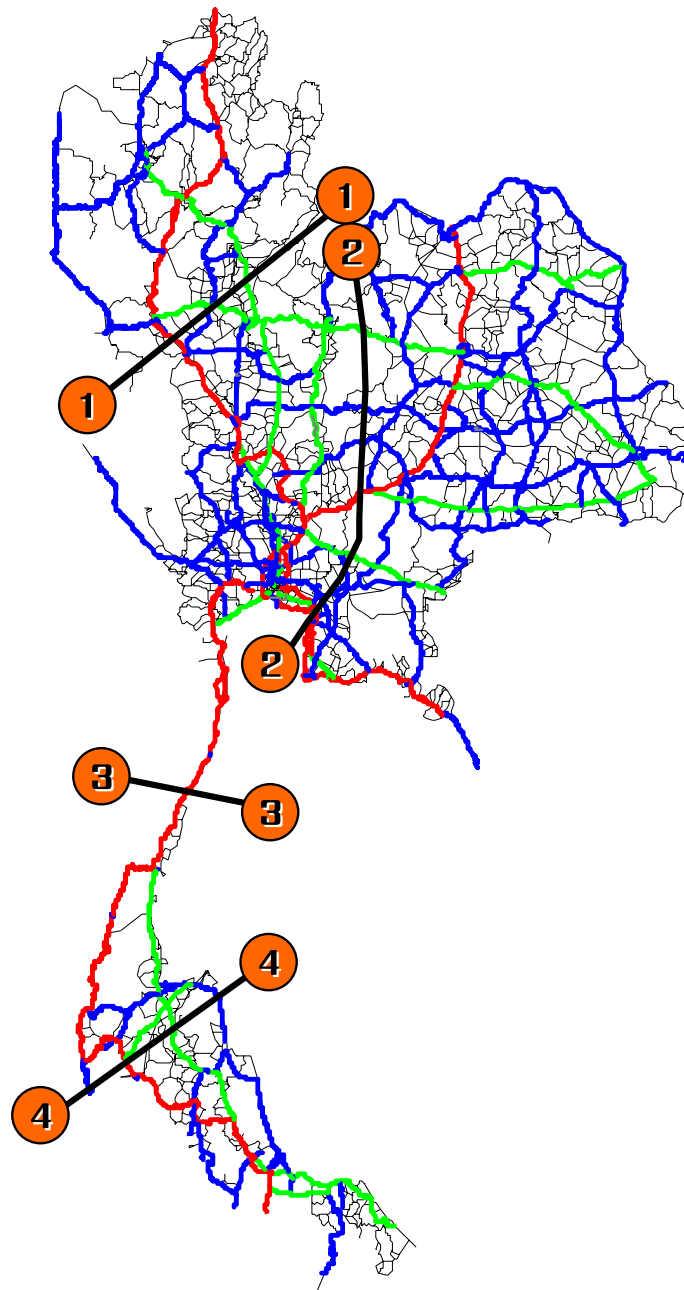


Figure 3.5 Screenline locations used for NAM model validation

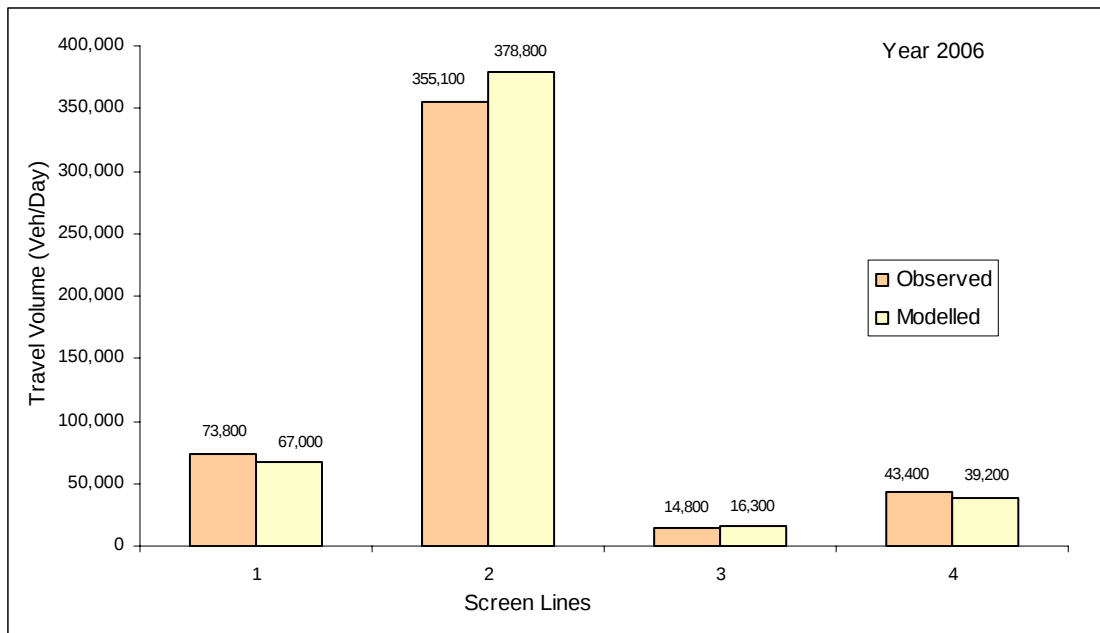


Figure 3.6 Validation Result: Passenger Cars (Unit: vehicles/day)

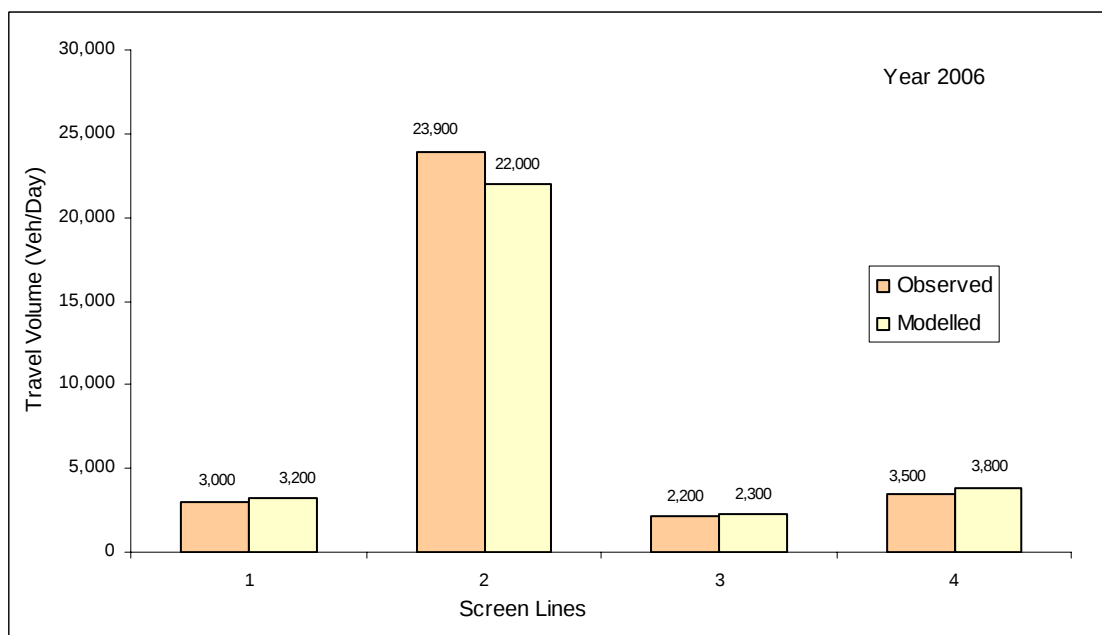


Figure 3.7 Validation Result: Buses (Unit: vehicles/day)

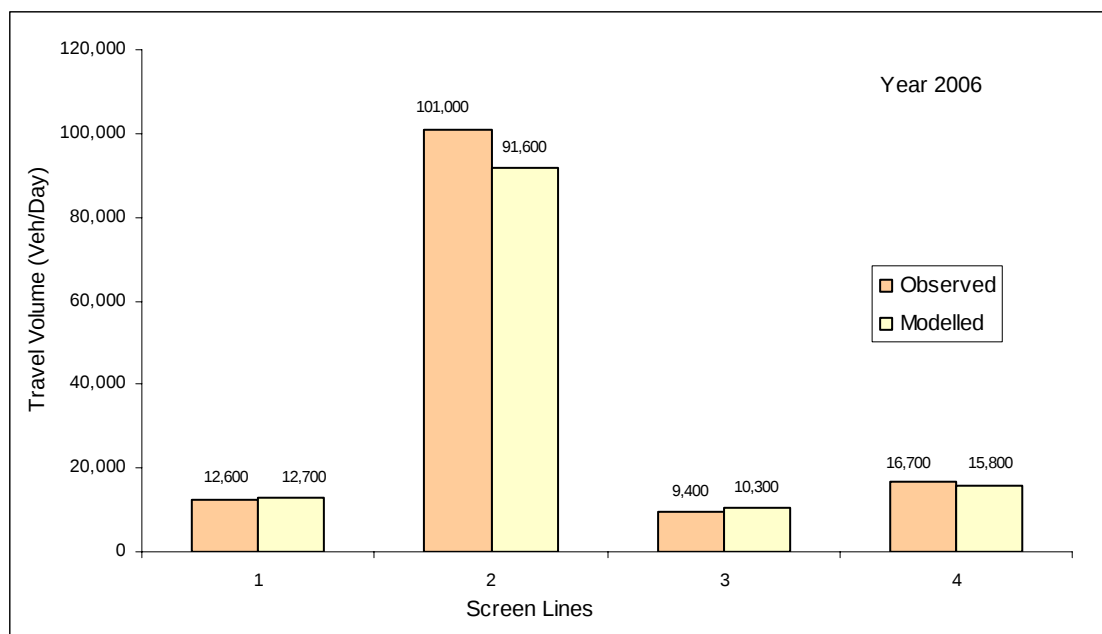


Figure 3.8 Validation Result: Trucks (Unit: vehicles/day)

Table 3.1 Results of person trips from NAM (1,000 trips/day)

Travel Mode	2007	2012	2017	2022	2027	2032
Passenger Car	1,484	1,865	2,455	3,244	4,205	5,681
Bus	903	1,133	1,495	1,931	2,513	3,413
Train	182	229	300	386	501	687
Air Transportation	31	38	50	65	84	112
Total	2,600	3,265	4,301	5,626	7,302	9,893

Table 3.2 Results of freight transportation from NAM (tons/day)

Travel Mode	2007	2012	2017	2022	2027	2032
Road	1,356,366	1,726,941	2,321,370	3,110,940	4,153,209	5,864,205
Train	47,762	60,812	81,745	109,548	146,251	206,501
Water	200,788	255,646	343,642	460,525	614,817	868,102
Air	170	210	283	390	521	735
Total	1,605,086	2,043,609	2,747,039	3,681,403	4,914,797	6,939,543

For the Local Area Model (LAM), the consultant has selected the area and developed the model in order to make LAM seamlessly be integrated with NAM, as shown in Figure 3.9-3.11.

The consultant has developed NAM for the daily trip in 2 time intervals, i.e. base year 2007 and future year 2012, 2017, 2022, 2027 and 2032.

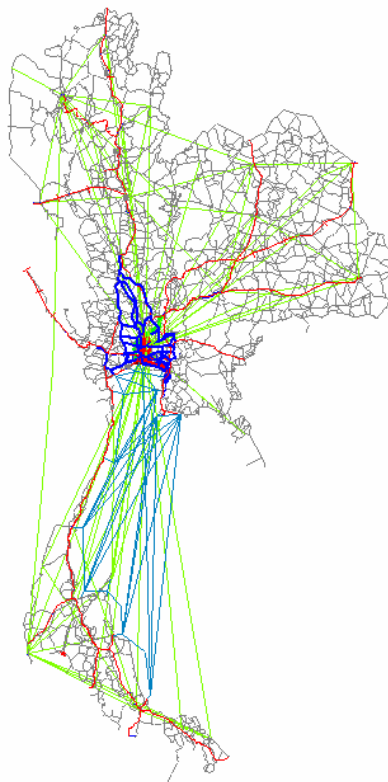


Figure 3.9 National Transport Network



Figure 3.10 Example of Grade Intersection in Cube Base

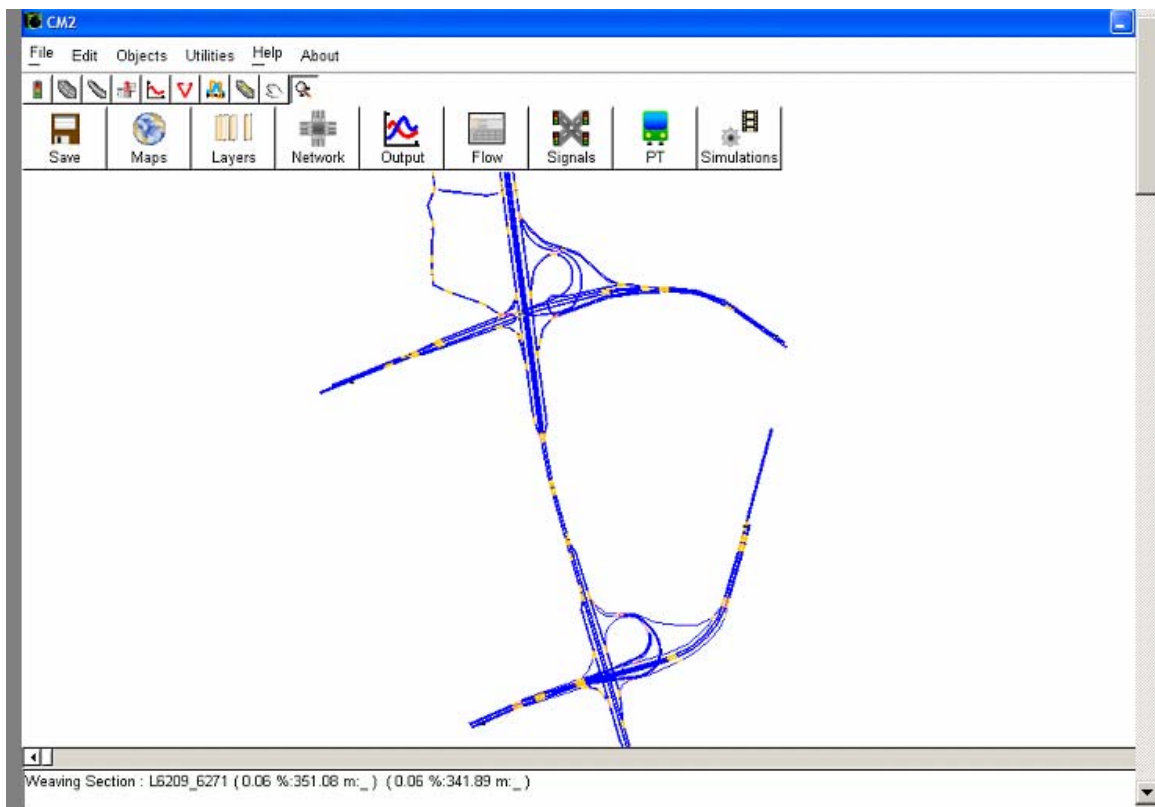


Figure 3.11 Example of Grade Intersection in Cube Dynasim

3.2.4 HDM-4

HDM-4 is an application program that has been used around the world for planning the work in the road projects which can analyze in every step, e.g. road maintenance, project appraisal, etc. In TDMC V, HDM-4 had been used for calculating the vehicle operating cost (VOC). For TDMC VI, this program has been already submitted to OTP.

3.3 Extended Bangkok Urban Model (eBUM)

The eBUM has been developed into the high level which can be applied to many types of works. This development comes from the cooperation of government and private users. The new features that are under consideration for inclusion in future versions of the Bangkok Transport Model include:

- Economic Evaluation Module (Figure 3.12)
- Only one time for skim estimation (Figure 3.13)
- Connection between data and real time system
- Cube Cargo can be applied in the model
- Environment Impact Module
- Usage of Mass Transit
- Boundary condition link with NAM

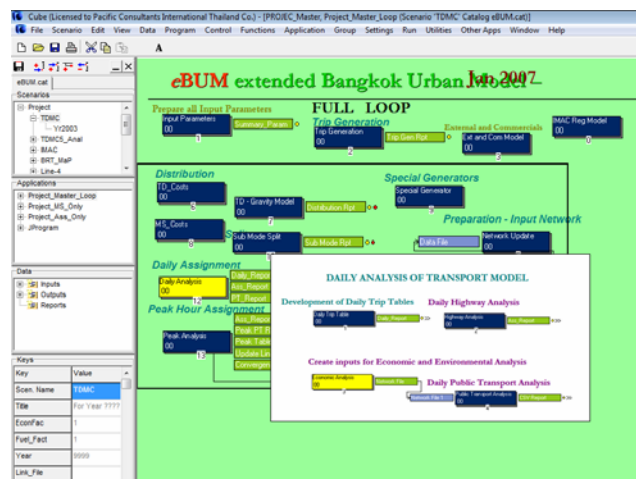


Figure 3.12 Economic Evaluation Module

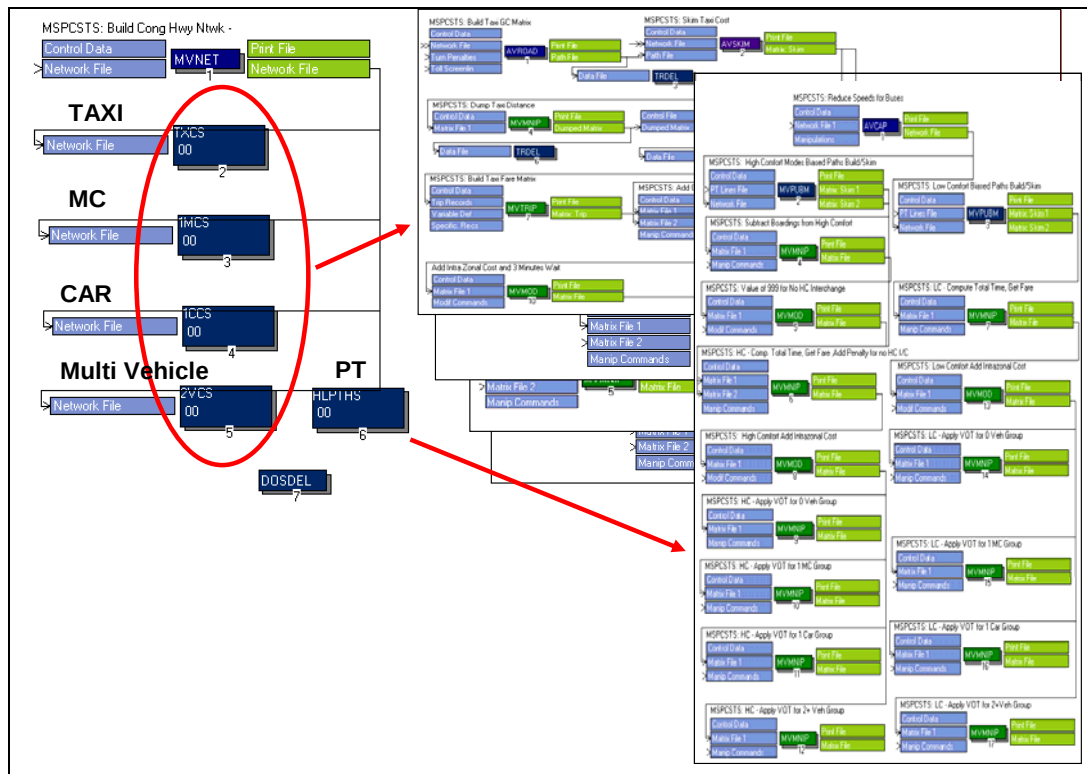


Figure 3.13a Skim Estimation (Before)

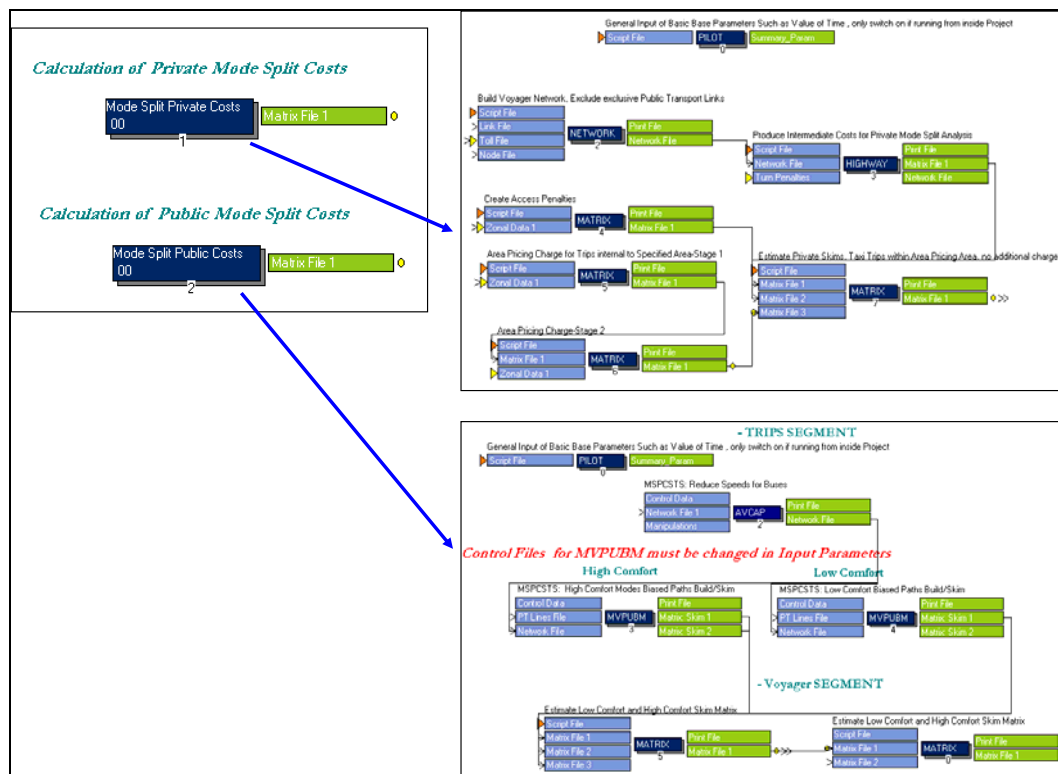


Figure 3.13b Skim Estimation (After)

The New Bangkok Transport Model – Validation

Although *eBUM* was validated against available data in 2005, it was a requirement of this project to validate the Bangkok transport model in 2007. Thus from this point onwards, the base year for *eBUM* is 2007. In order for this validation to proceed, the consultant adopted as input into this procedure the planning data for year 2007 developed for OTP during the IMAC study.

In the earlier model validation there was only one mass transit line in operation in Bangkok. However now in 2007 there are two mass transit operations in Bangkok namely the Green Line or BTS and the Blue Line or the Underground system. The newly validated model estimates that the Green and Blue Lines in 2007 attract 502,000 and 205,000 passenger boardings per day respectively. When compares these figures with an observed average ridership of 485,000¹ and 192,000 passengers per day respectively for the Green and Blue Lines. It can be seen that the difference are only 3.5% and 6.7% for the Green and Blue Lines respectively, see Table 3.3.

Table 3.3 Model validation for BTS passenger in 2007

BTS Line	Model (persons/day)	Survey (persons/day)	Differences (%)
Green	502,000	485,000	3.5
Blue	205,000	192,000	6.7

To ensure model stability the model loop was executed through several iterations for the year 2007. These iterations guaranteed the stability of the model after the inclusion of the impact of congestion. The model results were then compared with three screenlines for passenger movements. The screenlines are shown in Figure 3.14 and described in Table 3.4. The results from the vehicular screenlines are presented in Table 3.5. The traffic crossing the river included all bridges between the Western Outer Ring Road and the Rama IX bridge.

¹ These ridership estimates are daily average provided by the two operators in 2006.

Table 3.5 also presents a screenline comparison for vehicular movements across the river whilst Table 3.6 presents all passenger movements across three relevant screenlines. In all cases the results are well within the benchmark of 15%².

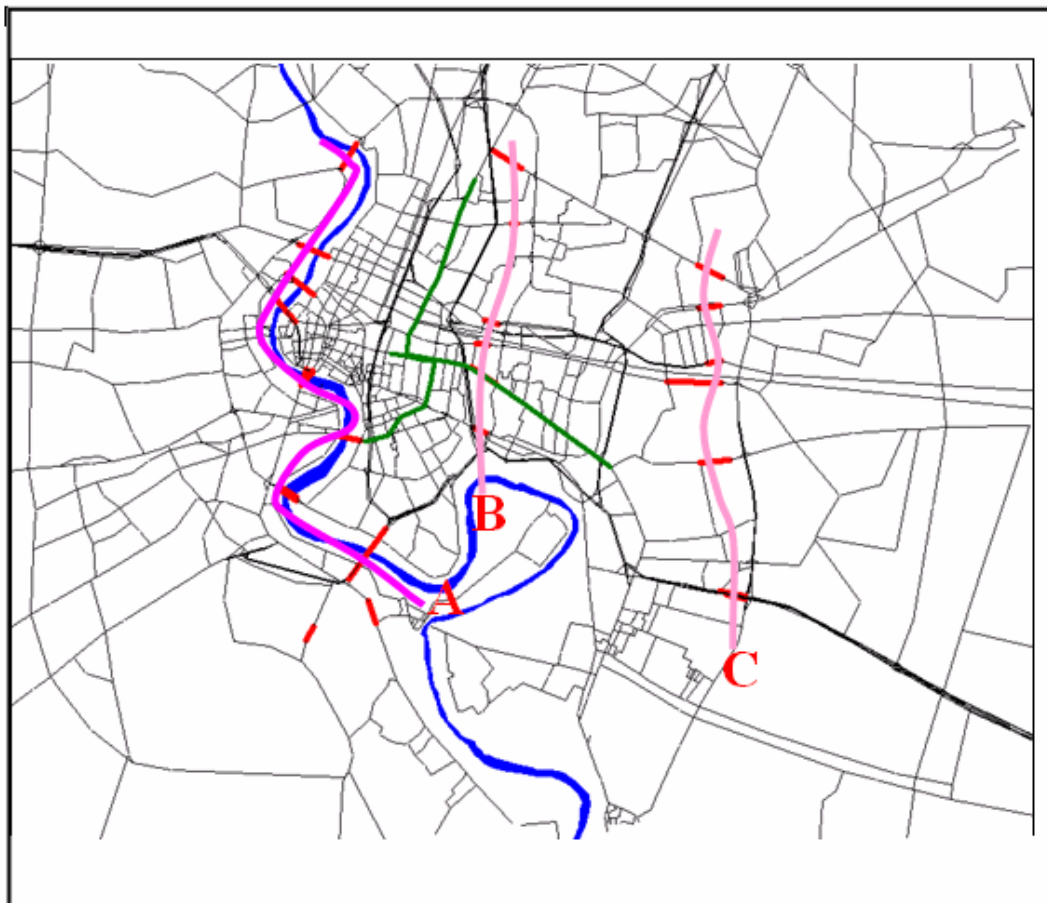


Figure 3.14 Locations of Screenlines

Table 3.4 Screenline Description

Screenline	Name	Description
A	City River Bridges	All Inner City Bridges from Rama VII Bridge South to Rama IX bridge
B	Inner East	Screenline from Lat Phrao in the North to Rama IV in the South.
C	Outer East	Screenline from Bang Kapi to Bang Na.

² In the earlier Urban Transport Database and Model Development(UTDM) project for OTP, the maximum variation for road Screenlines was set at 15% and for public transport at 25%.

Table 3.5 Daily Vehicular Screenline Traffic (PCU)

Screenline	Assignment	Count (Observed)	% Difference
River Inbound	701,000	718,000	2.4
River Outbound	694,000	715,000	2.9
River Total	1,395,000	1,433,000	2.7

Source: 1. BMTA Route Planning and Scheduling Study and TID II, DoH Traffic Counts from the East-West Feasibility Study. (This project counted traffic across the central river bridges and also was used to estimate growth in traffic counts from 2003 to 2006.)

2. Traffic Assignment is an estimate of the Consultant

Table 3.6 Daily Passenger Screenline

Screenline	Assignment	Count	% Difference
A	904,000	1,025,000	11.8
B	523,000	598,000	12.5
C	510,000	482,000	5.8

Source: 1. BMTA Route Planning and Scheduling Study and TID II, Growth from 2003 to 2006 is derived from the DoH's East-West Feasibility Study

2. Traffic Assignment is an estimate of the Consultant

The above comparison of screenline data results and mass transit estimates results in the conclusion that the model was replicating the existing situation and producing stable results, thus the model was considered validated against the base year of 2006.

Model Results

After model improvement and validation processes, the results of eBUM trip estimation for 2007 can be summarized as the following

- Trips in Bangkok and its circumference area, excluded trips from trucks, is about 15.65 million persons-trips/day
- HBW is 6.31 million trips from total 15.65 million trips about 40.3 percent from over all trip purposes as shown in Table 3.7
- Private trip in 2007 is taking about 57 percent from over all travel modes. These private trips are mostly family trips with one or multi vehicles. Table 3.8 presents the results
- Morning and afternoon peak hour in Bangkok and its circumference area has an average of travel speed at about 17.5 km/hr and 20.2 km/hr respectively.

- Results of passengers who use public transportations in Table 3.9 show that there are about 11.7 percent of persons who travel by using the mass public transportations such as BTS green line and MTA.

Table 3.7 Trip pattern in 2007 (Unit: million persons-trips/day)

Group	HBW	HBE	HBO	NHB	Total
0 Vehicle	1.85	1.03	0.64	0.19	3.71
1 Motorcycle	1.05	0.52	0.66	0.41	2.64
1 Car	1.42	1.04	1.17	0.74	4.38
Multi Veh.	2.00	0.95	1.08	0.90	4.93
Total	6.31	3.54	3.55	2.24	15.65

Table 3.8 Trips classified by number of vehicle owned and trip purposes in 2007

(Unit: thousand persons-trip/day)

Vehicle Group	Total Trips	Public Transport Trips	Private Trips	Public Transport Trips (%)	Private Trips (%)
0 Vehicle	3,709	3,090	618	83	17
1 Motorcycle	2,640	918	1,722	35	65
1 Car	4,378	1,488	2,889	34	66
Multi Vehicle	4,925	1,216	3,709	25	75
Total	15,651	6,713	8,938	43	57

Table 3.9 Public transportation users in 2007 (Unit: million persons-trips/day)

BTS Green Line	502
MRT Blue Line	205
SRT Rail	53
Bus	6,186

Trips in the Future

Traffic condition resulting from model evaluation can be classified into 2 characteristics which are non public transportation trips (motorcycle, tuk tuk, passenger car, taxi, pickup, and truck) and public transportation trips. Table 3.10 and 3.11 present these results. It can be seen that, approximately, number of trips will be increased from 15.6 million persons-trips/day in 2007 to 25.3 million persons-trips/day in 2032 or increased about 1.9 percent within 25 years. On the other hand, from trip purposes in Table 3.12, HBW will be approximately 41 percents from overall trip purposes of persons who use public transportation. Main public transportation networks are presented in Figure 3.15 - 3.19.

Table 3.10 Results from eBUM

Year	AM Peak				
	Total Person Trips	Total PCU Trips	Veh-Kms	Veh-Hrs	Speed(Kph)
2007	1,769,000	550,000	12,229,000	696,000	17.57
2012	1,930,000	628,000	14,313,000	914,000	15.66
2017	2,100,000	708,000	15,766,000	1,034,000	15.25
2022	2,271,000	774,000	17,483,000	1,245,000	14.04
2027	2,473,000	842,000	19,346,000	1,487,000	13.01
2032	2,721,000	925,000	21,599,000	1,880,000	11.49
Year	PM Peak				
	Total Person Trips	Total PCU Trips	Veh-Kms	Veh-Hrs	Speed(Kph)
2007	1,621,000	504,000	11,807,000	559,000	20.21
2012	1,766,000	574,000	13,719,000	720,000	18.01
2017	1,928,000	651,000	15,374,000	831,000	17.53
2022	2,099,000	716,000	17,152,000	1,022,000	16.15
2027	2,297,000	782,000	19,007,000	1,241,000	14.96
2032	2,539,000	863,000	21,253,000	1,569,000	13.21
Year	Daily				
	Total Person Trips	Total PCU Trips	Veh-Kms	Veh-Hrs	Speed(Kph)
2007	15,652,000	8,863,000	205,955,000	8,013,000	25.70
2012	17,266,000	10,044,000	237,546,000	9,912,000	23.97
2017	18,989,000	11,341,000	267,206,000	11,182,000	23.90
2022	20,760,000	12,460,000	296,495,000	13,301,000	22.26
2027	22,829,000	13,563,000	326,618,000	15,830,000	20.63
2032	25,370,000	14,893,000	365,441,000	19,702,000	18.55

Table 3.11 The number of passengers who use main public transportation system

	Passengers (1,000 persons-trips/day)					
	2007	2012	2017	2022	2027	2032
Red	-	549	923	1,595	2,443	2,951
Green	502	995	1,523	1,859	2,336	2,758
Blue	205	738	1,193	1,443	2,060	2,513
Orange	-	-	-	427	521	600
Yellow	-	-	-	-	291	377
Purple	-	118	192	896	1,229	1,481
Pink	-	-	-	-	231	280
Brown	-	-	-	-	37	69
Train	53	60	69	74	79	85
Bus	6,186	6,228	6,316	6,503	6,702	7,184

Table 3.12

Trip proportions classified by trip purposes and vehicle category (1,000 persons-trips/day)

Purpose	2007			2012			2017		
	PC	MC	PT	PC	MC	PT	PC	MC	PT
HBW	2,414	1,072	2,828	2,817	1,119	2,954	3,203	1,171	3,120
HBE	639	219	2,687	719	232	2,765	796	246	2,878
HBO	1,943	701	906	2,295	751	1,018	2,659	810	1,146
NHB	1,508	441	292	1,782	452	403	2,035	462	506
Total	6,504	2,434	6,713	7,614	2,553	7,141	8,693	2,689	7,650
Purpose	2022			2027			2032		
	PC	MC	PT	PC	MC	PT	PC	MC	PT
HBW	3,487	1,202	3,411	3,801	1,258	3,769	4,172	1,327	4,167
HBE	855	256	3,016	927	271	3,210	1,020	292	3,480
HBO	2,999	859	1,344	3,377	930	1,553	3,867	1,025	1,798
NHB	2,243	468	666	2,489	490	807	2,801	520	959
Total	9,585	2,785	8,437	10,594	2,949	9,338	11,859	3,164	10,403

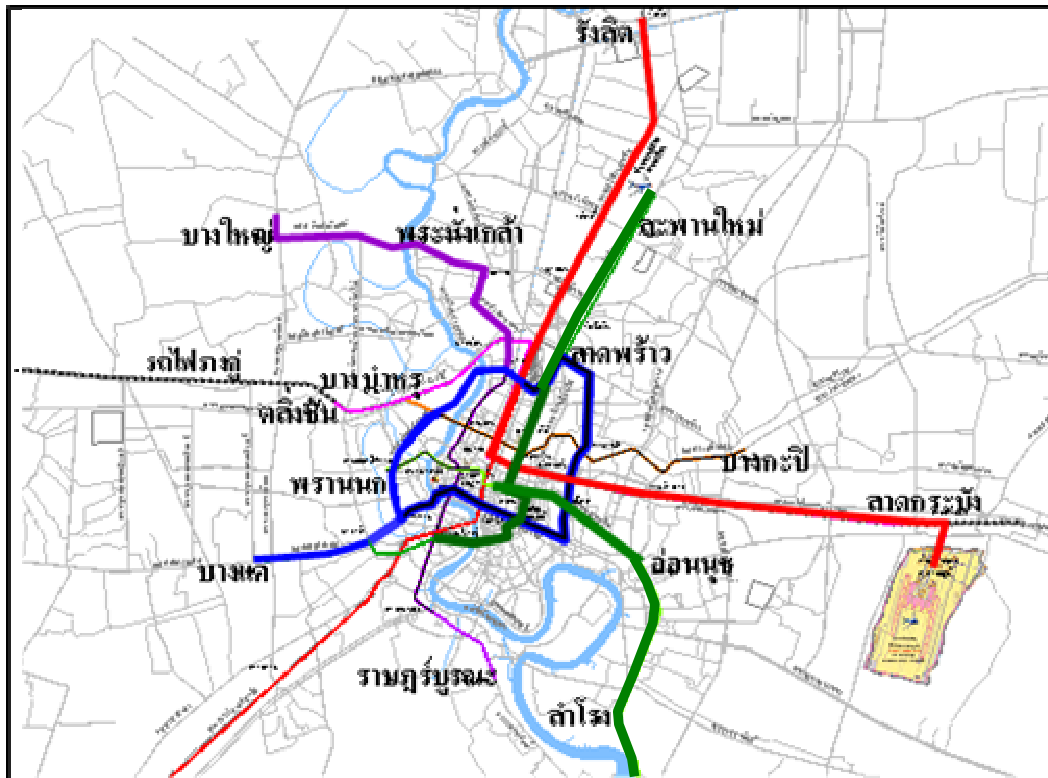


Figure 3.15 Rail public transportation network in 2012

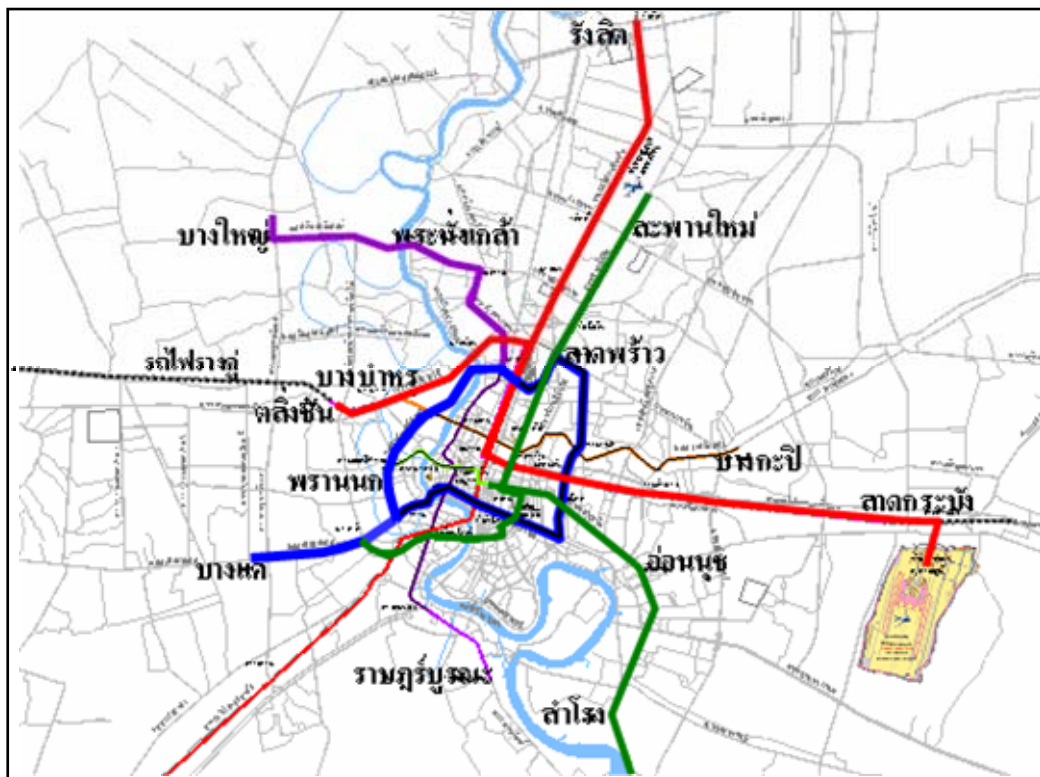
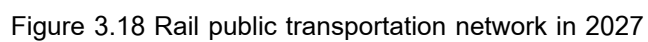


Figure 3.16 Rail public transportation network in 2017



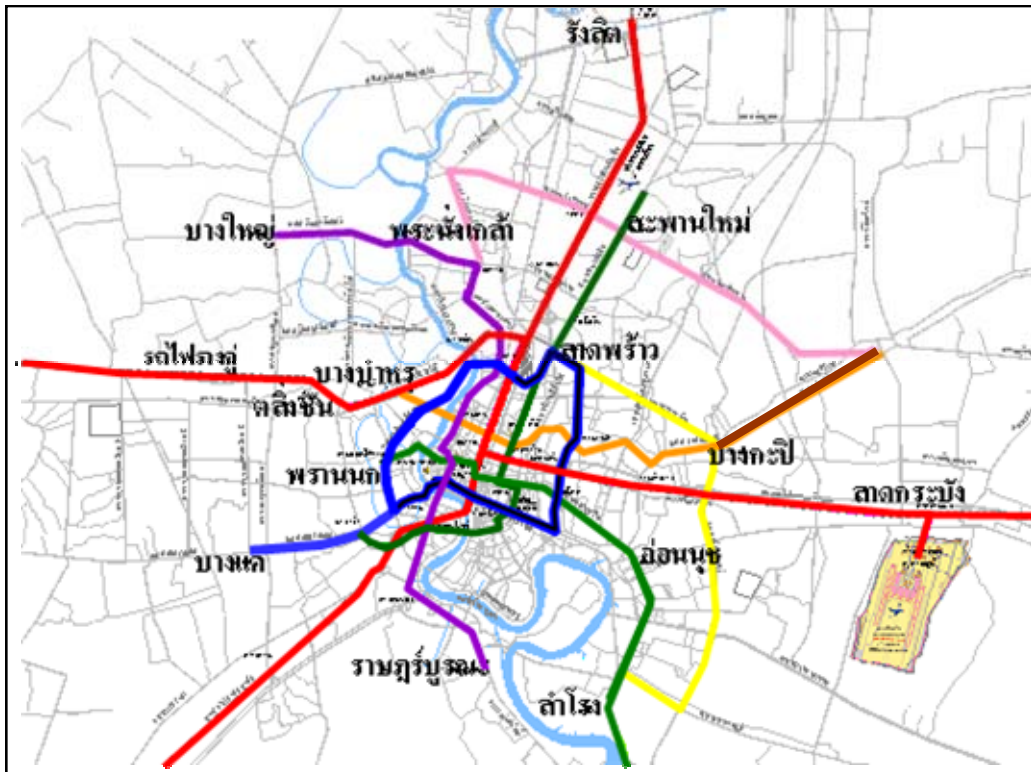


Figure 3.19 Rail public transportation network in 2031

3.4 Simulation Model Development

1) Local Area Model (LAM)

Local Area Model (LAM) has the main objective to model the real traffic environment and to be used as a tool for testing several traffic management procedures as well as the intersection or roadway network improvements. There are several LAM models that were developed in the past as the following summary.

- Urban and Transport Data Model Center (UTDM) developed LAM in 3 areas include Bangkapi, Silom, and Phetchaburi.
- Transport Data and Model Center (TDMC) project in 1997 extended the development of LAM for the other 4 areas, include Huamak, Pratunam, Krung Ratana Kosin, and Sanam Pao.
- Transport Data and Model Center II (TDMC II) in 2001 extended the development of LAM to cover the area of Rachada Phisek ring road and the area of industrial ring road.

- Transport Data and Model Center III (TDMC III) in 2004 developed the Mesoscopic traffic management model. This model covers 11 intersections within the area of Phetchaburi road, Bantad Thong road, Rama I road, and Wireless road.
- Transport Data and Model Center IV in 2005 developed microscopic simulation model using CUBE Dynasim. This model covers the intersections within the area of Ratana Kosin Island. The project also developed the manual of microscopic simulation model development.

2) Microscopic Simulation Model Development

In this project, the consultant has developed microscopic simulation models for the areas of main provinces including Chiangmai and Songkhla. The processes of the microscopic simulation development in this project are divided into two main parts, “traffic survey” and “microscopic simulation model development”. The summary of these parts are as follows:

2.1) Traffic Survey

The consultant collected mid-block traffic volume data along the selected corridors in the study areas. Figure 3.20 and figure 3.21 present the surveyed mid-block locations. The followings are summary of these surveys.

2.1.1) Traffic Survey in Chiangmai Province

The consultant collected the traffic count data at nineteen mid-block locations. The data were separated into 10 types of vehicles. Additionally, the data were collected in the 12 hour period (6:00 am to 6:00 pm) at MB1 and MB12. On the other hand, the data of MB2 to MB11 and MB13 to MB19 were collected by separating vehicles into 3 types (passenger car, bus, and truck). The data of these locations were collected from 9:45 am to 13:15 pm. Table 3.13 summarizes the survey locations and periods. Figure 3.20 presents the survey locations.

Table 3.13 Traffic Survey in Chiangmai Province

Date	Time	Locations
Nov 27 th , 2007	09.45-13.15	MB2 MB3 MB4 MB5 MB6 MB7 MB8 MB11 MB18
	06.00-18.00	MB1
Nov 28 th , 2007	09.45-13.15	MB9 MB10 MB13 MB14 MB15 MB16 MB17 MB19
	06.00-18.00	MB12

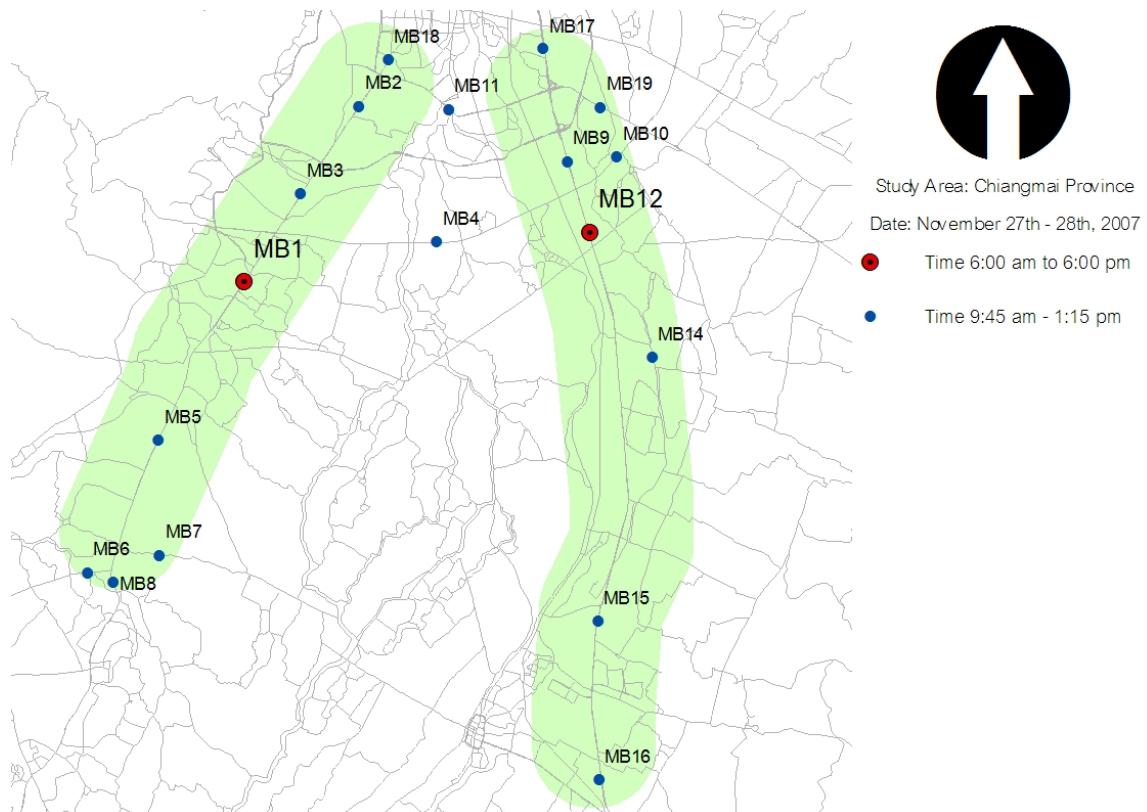


Figure 3.20 Mid-Block Traffic Count Locations (Chiangmai Province)

2.1.2) Traffic Survey in Songkhla Province

The consultant collected the traffic count data in seventeen mid-block locations. The data were separated into 10 types of vehicles. Additionally, the data were collected in the 12 hour period (6:00 am to 6:00 pm) at MB1 and MB16. On the other hand, the data of MB2 to MB15 and MB17 were collected the traffic count data by separating vehicles into 3 types (passenger car, bus, and truck). The data of these locations were collected from 9:45 am to 13:15 pm. Table 3.14 summarizes the survey locations and periods. Figure 3.21 presents the survey locations.

Table 3.14 Traffic Survey in Songkhla Province

Date	Time	Location
Nov 29 th , 2007	09.45-13.15	MB2 MB3 MB4 MB5 MB6 MB7 MB8 MB17
	06.00-18.00	MB1
Nov 30 th , 2007	09.45-13.15	MB9 MB10 MB11 MB12 MB13 MB14 MB15
	06.00-18.00	MB16

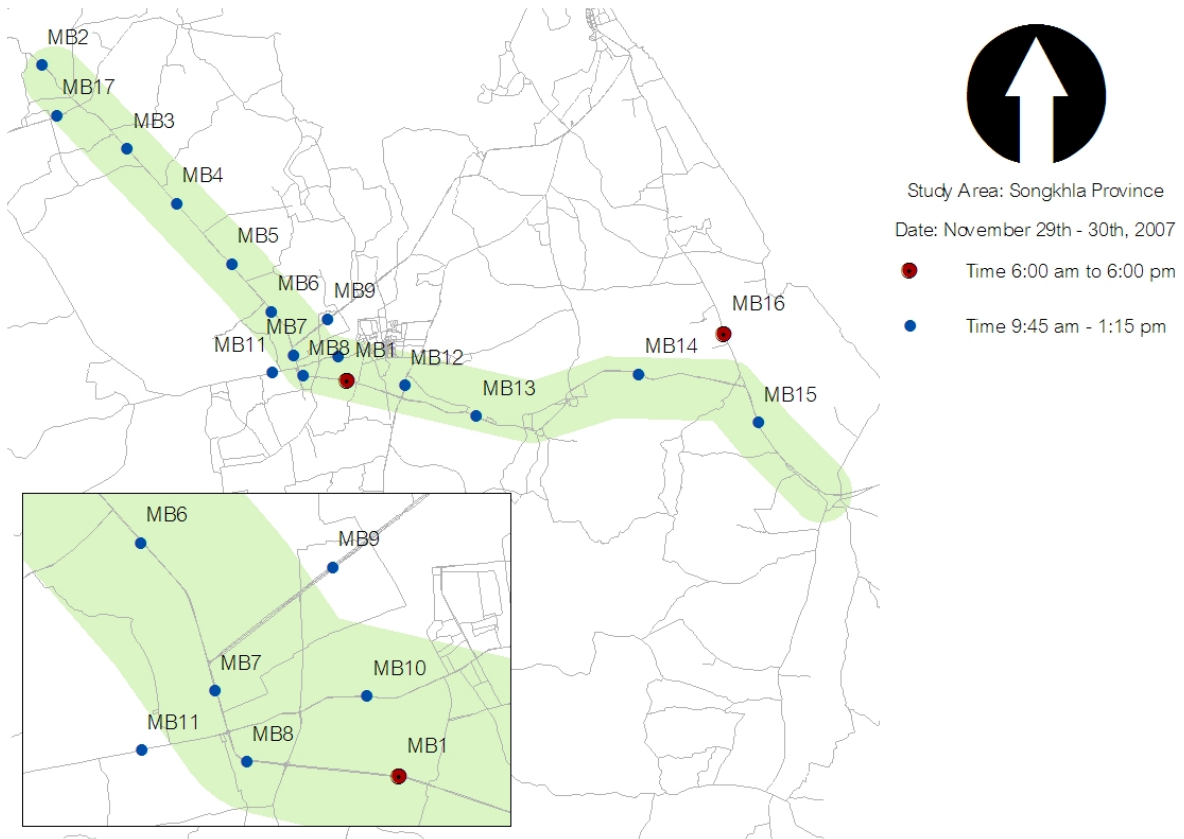


Figure 3.21 Mid-Block Traffic Count Locations (Songkhla Province)

2.2) Microscopic Simulation Model Development

In TDMC VI, the consultant developed the microscopic simulation model by using CUBE Dynasim program, as those used in TDMC IV project. The reason is caused of the ability of the program that can be connected with CUBE Voyager, also owned by OTP. Hence, it is also be able to connect with NAM and eBUM model.

Additionally, TDMC VI also used the roadway network which is developed by Ministry of Transportation. This roadway network is called Transport Fundamental Geographic Data Set or Transport FGDS. The potentials of this network are its true shape format and one way links codes. These potentials help to transform the network from CUBE Voyager to CUBE Dynasim software. This transformation process makes micro-simulation model building easier than those in the TDMC IV, especially the problems with the path files are eliminated. The steps of microscopic simulation model development could be summarized as the followings.

1. Evaluating the Transport FGDS Network and Preparing Other Input Data

The work in this step is to evaluate the results of exporting the Transport FGDS network from CUBE Voyager to CUBE Dynasim. The work is also be involved in the implementation processes in order to add the additional attribute data into the Transport FGDS network's database. This additional attributes are, for example, Node A, Node B, Capacity, Speed, and Distance, etc. Furthermore, the other input data that are needed to prepare in this step are traffic survey data, satellite image, layout of roadway geometric boundary, and link-node diagram.

2. Development of Intersection Traffic Control Data

There are two different processes for implementing traffic control data into the model. The first method is directly entry the data into CUBE Dynasim. The other method codes the data into CUBE Voyager/Base before transferring the model into CUBE Dynasim. In TDMC VI, the consultant evaluated the alternative in coding the data into the CUBE Voyager/Base before transferring the model to CUBE Dynasim. Implementing the intersection control data from CUBE Voyager will help to reduce the coding processes CUBE Dynasim. However, as the Transport FGDS data are in the format of "one way link type", the intersection nodes cannot be defined in CUBE Voyager. Hence, the intersection control data still have to be inserted to the model directly in CUBE Dynasim.

3. Estimating the Original-Destination (O-D) Trip Table

In this step the roadway networks as well as the input data that are prepared in step 1 were used as the inputs for the analysis of O-D trip table and travel route (path) data. It should be emphasized here that one of the most important data in this step is the mid-block traffic survey (topic 2.1). Matrix Estimation program (Analyst) which is a CUBE extension program was used to analyse the O-D trip table and path files for the model in both areas (Chiangmai province and Songkhla province). The most important data in this step is the traffic survey which has collected in the field as mentioned in section 2.1. Figure 3.22 presents the example of Matrix Estimation program.

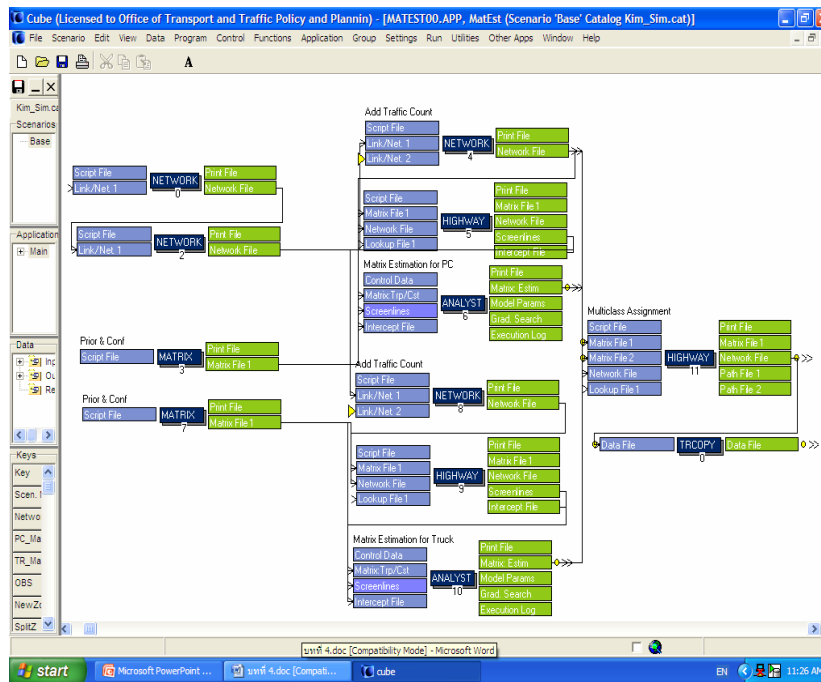


Figure 3.22 Example of Matrix Estimation in CUBE

4. Model Modification and Implementation in CUBE Dynasim

This step is concentrated on modification and implement of the roadway network in CUBE Dynasim after the transferring process. The modification and implementation is one of the important step in microscopic model development. The main modeling issues that were checked in this process are:

- 1) checking all input data in CUBE Dynasim (exported data)
- 2) evaluating flow of vehicles in the model
- 3) evaluating traffic characteristics in the model
- 4) evaluating roadway and intersection geometry in the model

The errors that are found in prior issues will directly affect the level of accuracy of the model validations. Figure 3.23 presents the example of output in CUBE Dynasim.

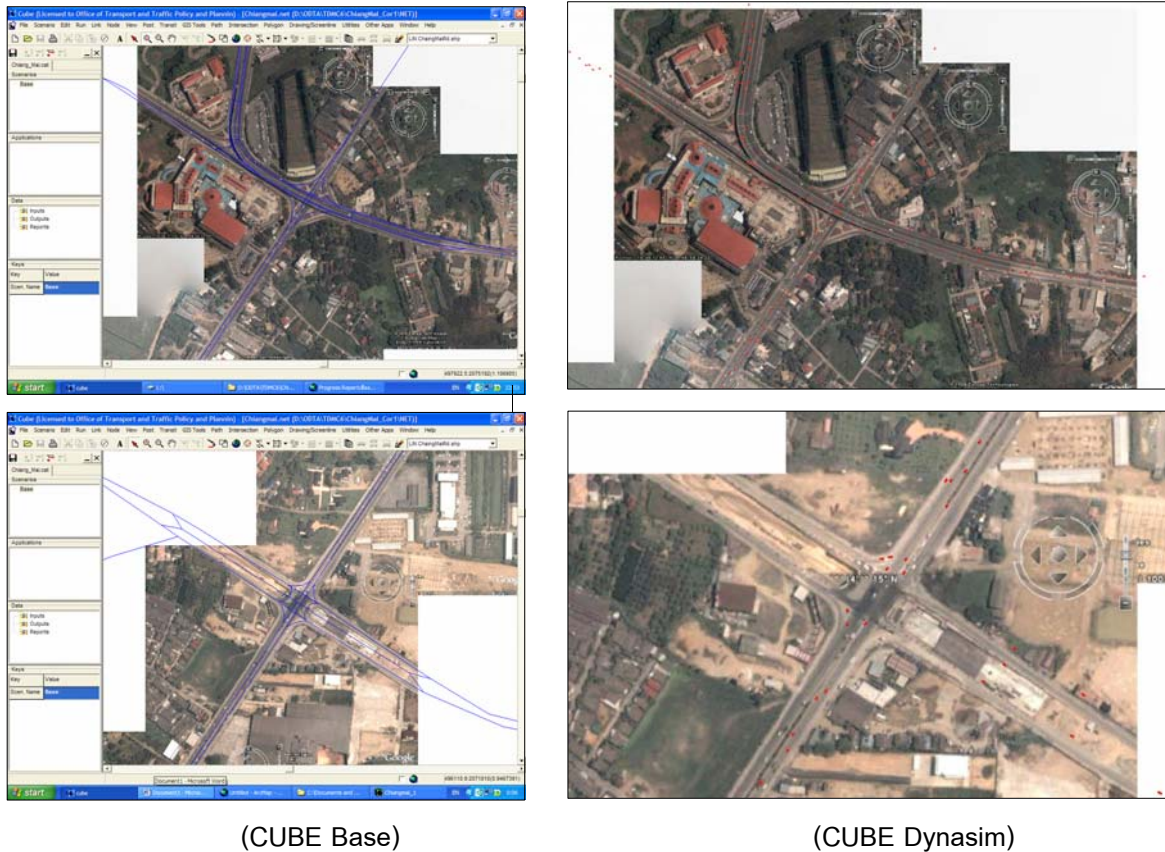


Figure 3.23 Example of Output from CUBE Dynasim (Chiangmai Province)

5. Model Validation Process

The model validation has the objective of ensuring the results of the simulation model are match with the existing traffic condition in the study area. In general, the model validation can be done by comparing the average parameters that are gathered from the simulation model after several run to the existing parameters that were collected from the field. The process will be repeated until the simulation model can represent the appropriate results of these parameters. However, it is impossible to validate all the traffic characteristics or parameters in the model. Hence, the validation targets are differences from projects to projects depending on data availabilities and budgets. In TDMC VI, the consultant selected the traffic volume at several midblock locations as the validation parameter by comparing the results of average traffic volume from the simulation models to those from the field surveys (topic 2.1).

Normally, the problems or source of errors in the validation process are geometry of study area, the accuracy of model input data, model parameters (default or local setup), and number of intersections involved in the model. For the models that were developed in this project, the source of errors would be types of vehicles that are simulated (accuracy of model input data). CUBE Dynasim version 1.14 can

support only two types of vehicles (excluded the public transportation) that are Passenger Car and Truck. Hence, Motorcycles are converted to Passenger Car (using the Passenger Car Equivalent-PCE Factor) in order to use as the input in the simulation models. Further, the other sources of errors might be from the accuracy of traffic surveys or the incomplete traffic signal data. Further, the other source of errors could be caused of the model default parameters in CUBE Dynasim which were developed to represent the traffic characteristics in foreign countries. Using these default parameters to simulate traffic in the study areas without the calibration process may affect the accuracy of model validation results. The example of these defaults parameters is the driving behavior parameters.

3.5 Model Integration between NAM and eBUM

Recently, eBUM and NAM have been integrated almost seamlessly. One of the problem is that the number of BMR zones of NAM is only 79 zones which is coarser than zones in eBUM (761 zones). (Figure 3.24) However, 24 external zones of eBUM are the main routes to enter BMR which can be compared with the main routes to enter BMR of NAM.

Therefore, in the development of connection between NAM and eBUM, Selected Link Analysis should be applied to those main routes first. This should concern both private trips and freight transport by road of NAM (only for the trip that has origin/ destination in BMR or pass through BMR) in order to develop the O-D trip table of main route which should be corresponded to external zones of eBUM. Then, the trips are distributed in the O-D trip table from the coarser zones in NAM to the finer zones than that of eBUM. The ratio of private trip will be the same as the ratio of the private trip in the O-D trip table of eBUM. The ratio of freight will be the same as the ratio of the freight in the O-D trip table of eBUM. Or the ratio of secondary employment in BMR can be applied.

Final step is to distribute the O-D trip table to be into the vehicle types which correspond to the Modal Split Model of eBUM. The freight transport by intercity train and bus is also analyzed with the same method.

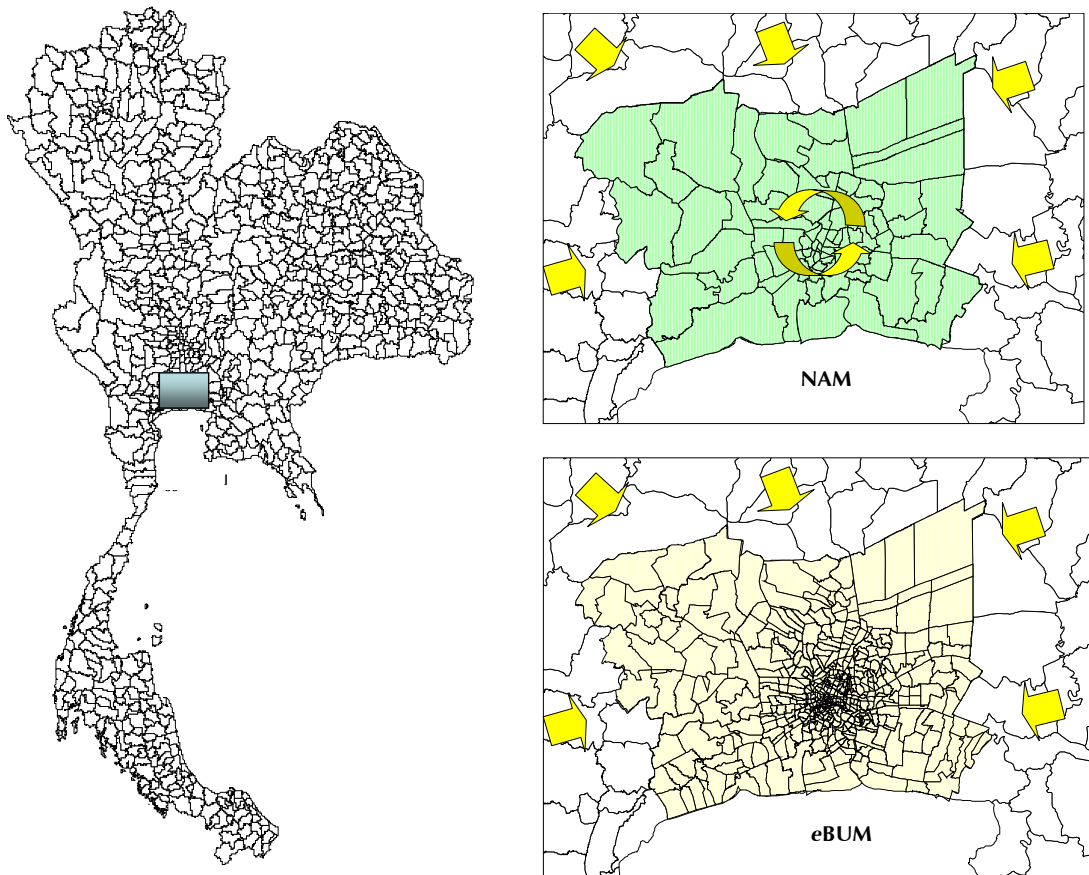


Figure 3.24 BMR Zones in NAM and eBUM