6.4 Database Created in the Study

1) Sources of Data

The data collected in this study can be classified into four (4) categories below. All these data are necessary for constructing the strategic cross-border transport planning model. The collected data were compiled using GIS to the extent possible.

(1) Traffic demand and international trade;
(2) Socioeconomic indicators (production, employment, population, etc.);
(3) Industrial input-output tables; and
(4) Transport network.

(1) Traffic Demand and International Trade

Concerning the current status of traffic volumes on the GMS transport network, the database on the Asian Highway developed by UNESCAP is the most significant source. It includes road inventory and was used by the ADB's *GMS Transport Sector Strategy Study* as well. As to OD data, some countries have domestic OD data, which was prepared in various JICA development studies. OD data between countries (cross-border transport and trading) is available from the ADB study. These OD tables consist of passenger and goods flows by mode of transport (partially including waterways)..The ITT model also uses OD data on containers, which has not been obtained yet.

On the other hand, only the value of international trade is available from JETRO. There is scarcely information on weight or TEU by cargo item. Thus, a lot of effort will be needed in the future to collect such trade information.

Table 6.4.1 Status of OD Data[1)] on Transport Demand in the Greater Mekong Subregion

	Thailand	Vietnam	Laos	Cambodia	Myanmar	China/ Yunnan Prov.	GMS
Domestic OD [2)]	-	o (JICA)	o (JICA)	o (JICA)	x	-	-
Cross-Border OD [3)]	-	o (JICA)	x	-	x	-	o (ADB)
International Trade OD [4)]	o	o	-	-	-	-	-

1) As of October 2006.
2) o:OD data was compiled in the *National Transport Development Strategy Study in the Socialist Republic of Vietnam* (JICA, 2000), *The Study on Road Network Development in the Kingdom of Cambodia* (JICA, 2005), and *The Study on Improvement of Roads in the Southern Region in Lao People's Democratic Repu*blic (JICA, 2003) x: Incomplete -:unknown.
3) o: *National Transport Development Strategy Study in the Socialist Republic of Vietnam* (JICA, 2000) and TA No.6195 - REG: *GMS Transport Sector Strategy Study* (ADB Mekong Office, 2005) made OD tables for cross-border transport for subject GMS countries, thereby demand estimate of freight transport is possible. x: Incomplete, -: unknown.
4) o: Each country's trade statistics are published by either the tax agency or the national statistics bureau. Multinational trade statistics by country are available at the International Trade Investment Institute of IMF and at the Asia Economic Research Institute of Japan, both of which have prepared International trade matrices by type of goods. x: Incomplete, -: unknown.

(2) Socioeconomic Indicators

National socioeconomic indicators, such as population, employment, industry, and production, are available for almost all GMS countries. But the construction of the strategic cross-border transport planning model requires more detailed data by area or province.

Population data by province can be obtained in national statistics offices and the ADB study. However, there is little time-series information available that can be collated with the survey year, and changes in administrative units, such as the integration or the abolition of provinces, make data scarcer. Data other than population is also almost nil.

(3) Industrial Input-Output Tables

When constructing the regional economy model, there is a need to understand how CBTI development impact will spread among the industries and the region. For this purpose, industrial input-output tables are the most suitable.

The 5 countries and 2 provinces (of China) in the Greater Mekong Subregion are entirely different in social systems, human resources, administration, and technology levels. Understanding the real economic conditions is made more difficult due partly to the tight disclosure of information. The current situation is summarized in Table 6.4.1. Countries that publicly announce official national industrial input-output statistics are Thailand, China, and Vietnam, while Lao PDR, Cambodia, and Myanmar do not have such data so far, except for industrial input-output tables made in part by researchers. As for regional and provincial industrial input-output tables, the only ones available are for Yunnan Province in China (Statistics Bureau) and those in a handful of case studies done by researchers.

Table 6.4.2 Current Status of Industrial Input-Output Tables of GMS Countries[1)]

Year / Content/Type of Industrial Liaison Table				1980	1995	1996	2000	Output/Organizations Involved
				Basic Table	Extended table	Basic Table	Basic Table	
Domestic	Vietnam	National Table		○	○	○	○	GSO[3)] (prepared by AREES[1)] member)
		Regional Table	Hong Ha Region	○	×	×	×	GSO-ADB (prepared by AREES member)
			HCM urban zone	×	×	○	○	AREES
			Danang urban zone	×	×	×	○	AREES
			Hanoi urban zone	×	×	×	○	AREES
			Haiphong urban zone	×	×	×	○	AREES
			QUANGTRI	×	×	×	○	ADB
		Table between Regions	Between HCM urban zone and others in vietnam	×	×	○	○	AREES
			Hanoi urban zone and others in	×	×	×	○	AREES
			Between HCM urban zone, Danang urban zone and others in Vietnam	×	×	×	○	AREES
			Industrial Liaison Table among regions in Vietnam	×	×	×	○	AREES
	Lao PDR	National Table		×	×	×	×	NSC[3)] as Administration Organization involved
		Regional Table	Savanakhet	×	×	×	○	output by AREES member
	Cambodia	National Table		×	×	×	○	AREES
	Thailand	National Table		×	○	×	○	NESDB[3)]
		Regional Table	Regional Industrial Liaison Table in Thailand	○(20 Sections)	×	×	×	Prepared by keio University
		Table between Regions	Regional Industrial Liaison Table in Thailand	○(20 Sections)	×	×	×	Prepared by keio University
	China	National Table		○(1987)	×	×	○	Chinese State Affairs Administration
		Within Region's Table	Table of Yunan Province	○(1987)	○(92)	○(97)	○(2002)	Statistics Burcau of Yunnan province [2)]
			Others and each Provincial table within Province	○(1987)	○(92)	○(97)	○(2002)	Respective Statistics Bureau
		Among Regions's Table	Table among Nationalwide 7 Regions	○(1987)	×	×	×	UNSRD-Chinese State Affairs Administration
			Table among Nationalwide 29 Regions	×	×	○	×	Nagoya University (Ezaki)-Chinese State Affairs Administration
			Table among Nationalwide 8 Regions	×	×	×	○	IDE -Economic Forecast by national Information Center
Overseas	Indochina	Table between 2 countries	Thailans-Vietnam	×	○	×	×	IDE-NESDB
			Vietnam-Cambodia	×	×	×	×	AREES
	Others in Asia	Among Multi-nationals	International industrial Liaison Table of Asia	○(1985 and 1990 Yearly Table)	○	×	○	IDE

Sources: AREES, NIS(Cambodia), GSO(Vietnam), NESDB(Thailand), NSC(Laos), SBYP(Yunnan Province), ADB, UN-ECAP, and hearings from IDE, etc.

Note: 1) As of October 2006.
2) AREES: Association of Regional Economic Environment Studies, a human network of experts at statistics bureau of respective country and local economists. Data is not open to the public
3) IO Table within the region of Yunnan Province in China has been prepared (e.g. Kunming City, 1997, and 2002).
4) NIS, GSO, NESDB, NSC, and SBYP are national statistics bureau or working group on IO table of each country.

(4) **Transport Network**

CBTI development is not only related to passenger traffic and logistics flow across national borders; it also contributes to the entire region as part of the nationwide transport and trade network through linkages to the domestic network. This network, including shipping and air, is one of the indispensable databases for transport planning. Network data on road, railroad, and water transport, which were developed in the ADB *GMS Transport Strategy Study*, are available for the study.

The transport network comprises nodes that connect points at intersections and intermodal terminals, as well as links that are sections of roads, railroad, and waterway. Each link has impedance parameters, such as travel speed and travel cost. It is necessary to examine how to set up link parameters logically, where GIS is effectively used.

2) **Database Prepared in the Study**

In this study, all collected data were compiled in a unified style using GIS to the maximum extent.

GIS is capable of having both positional information and numerical/alphabetical data at the same time. Overlaying these data facilitates an understanding of the interrelationship between different data.

Figure 6.4.1 Display Example by GIS

6.5 Data Requirement and Possibility of Collection

1) Necessity of Database Establishment

To effectively pursue CBTI development, there is a need to investigate the actual traffic flows in the planning area and to grasp quantitatively the impact of the CBTI project package, based on which the priority of the individual projects should be determined. After CBTI development, monitoring of project outcomes and impacts is important to learn the lessons and to feed them back to planning.

A variety of data at the regional or subregional level and compiled in a standardized format are essential in constructing the strategic cross-border transport planning model. This is essential for JICA to extend efficient technical cooperation to concerned countries and to confer with them from a sound technical basis. The need for a quantitative database is present from planning to implementation stage, as follows:

(1) Database for understanding current CBTI situation

To start CBTI development, it is necessary to understand current CBTI status (including existing plans). It is especially important to know quantitatively the present constraints to CBTI development. The necessary task is to collect information and construct a database that enables comparison.

(2) Database for planning CBTI

Planning is required prior to CBTI implementation. It is imperative to understand what kind of CBTI would be most effective in light of limited resources. In other words, project benefits must be quantified in advance. The strategic cross-border transport planning model, which combines the transport and regional economy models, would serve this purpose well. But, this requires another database covering various planning parameters including forecast output.

(3) Database for monitoring completed CBTI

For the purpose of measuring the impacts of CBTI development across a region/ subregion, it is necessary to continuously monitor various performance indicators. To conduct this successfully, the improvement and the updating of the created database are essential. This also requires establishing or assigning an appropriate organization to monitor the database properly.

2) **Outline of Planned Database**

A database that includes transport and socioeconomic indicators is needed for CBTI development in the Greater Mekong Subregion. The database should preferably have the following features:

(1) **Database Types and Compilation Methods**

Needed data for the CBTI development plan as well as for constructing the model are shown in Table 6.5.1.

Each data is compiled as a GIS data with positional information, as ASCII data file or table, and as a descriptive document, depending on the data characteristics. In the case of the CGEurope model, the transport network is saved as a GIS data, while all other data are stored as data files following the ASCII format. Since descriptive documents cannot be processed in a systematic manner, storing them in other formats is suggested.

Table 6.5.1 Database Types and Storage Methods

Type of database \ Data saving method	GIS	ASCII File	Docu-ment
Indicator by country (GDP, legal system, etc.)	○	○	○
Indicator by zone (province or special city)	○	○	
Cross-border point information	○	○	○
Cross-border regional information (area development, facility, project information)	○	○	○
AH road and other road network information	○	○	
Railroad network (incl. major stations) information	○	○	
Waterway (incl. port/harbor locations) information	○	○	
Air transport (airport location) information	○	○	
OD table (land, sea, air) passenger, ton/value		○	
Industrial IO table, Social Accounting Matrix (SAM)		○	

(2) **Basic Structure of Database**

Data items included in each database mentioned above are shown in Table 6.5.2. The following should be considered in database construction:

Time-series Changes

All data should preferably be collected in a time series excluding some nationwide indicators depending on country. The CGEurope model collects data once every 5 years. This study also recommends such data collection. The target should be to collect all the data in the same year for all countries and regions covered in a study.

Setting of Unified Code

It is preferable to set a unified code to allow mutual referencing between data items. Referencing becomes easier and errors are lesser if simple alphanumerical codes are used rather than region names and data names.

Consideration of Expandability

The database should have a flexible format to allow adding data for additional year or field. CGEurope adopts a format wherein regional data is inputted following each regional code, while interregional data is inputted following all the related regional codes.

Quick Retrieval of Data

When a database is constructed, consideration must be given to quick retrieval of data. Also, data saving methods that require special software should be avoided. For example, if a database is constructed on Excel, the data should be saved as CSV formatted text file, except when analysis is executed. Saving by paper (printed material) should be avoided as well.

Table 6.5.2 Contents of Database

Type of database	Content
Indicator by country	History, area, population, race, language, religion, political system, administrative organization, economy (major industry, GDP, economic growth rate, consumer price index, unemployment rate, trade value, trade item, trading partner, currency, exchange rate), foreign policy (budget, military power), bilateral relationship with Japan, economic cooperation
Indicator by zone (Province)	Capital (provincial capital), area, habitable area, population (by age group, by sex, birth/death rate, natural increase, social increase, employment, unemployment), economy (major industry, GDP, economic growth status, production value by industry), transport (generation/attraction by passenger/freight mode)
Cross-border point information	Location (border city), cross-border mode and dimension, traffic volume (passenger/freight flow), custom clearance (gate, visa, office), other infrastructure, etc.
Cross-border regional information	Regional development project, industry, number of employees, production value, energy demand/supply situation
AH road and other road network information	AH number, section number, length, class(width, number of lanes, pavement, road structure), traffic volumes by mode, current condition and development plan by section
Railroad (incl. major stations) network information	Route section code, length, standard (gauge), service frequency, transport capacity, fare/charge, scheduled speed, transport time, major stations, plan
Waterway (incl. location of seaport/harbor) information	Operating route, standard (displacement, goods transported), service frequency, transport volumes, major sea/river ports (location, handling capacity), transport fare/charge, transport time, plan
Air transport (incl. location of airport) information	Class (international, domestic), largest usable aircraft, service frequency by destination, transport volume by destination (passenger/freight flow), air control system, plan
OD table (land, sea, air)	OD transport volumes by mode, logistics OD volumes by product item (value, TEU)
Industrial IO table, Social Accounting Matrix (SAM)	Industrial IO table of about 10 Industries, social accounting matrix (SAM)

3) **Direction of Data Collection / Maintenance**

Data collection and database maintenance should be done taking into consideration the experiences of advanced countries. Since the Greater Mekong Subregion has no coordinated database, particularly with regard to CBTI development which requires detailed data in terms of zone unit and transport network, it is important for JICA to extend technical cooperation on the basis of Japan's experiences in database creation.

It is urgent to determine the concept of the overall database and to work out the policies for data collection in order to construct the strategic cross-border transport planning model for the implementation of CBTI development in the subregion. It is high time to start gathering valuable case data, such as consequent changes in traffic and regional economy following the completion of the Second International Mekong Bridge.

The possible methodologies for data gathering/maintenance could be as follows:

(1) **Cooperation with International Organizations**

Data collection should be promoted by sharing information and cooperating with international organizations, such as the ADB and UNESCAP, or with related organizations in the respective GMS countries.

It should be expected that the databases of these organizations do not follow a unified database system, and re-editing would be needed based on a uniform format. In addition, it is important to investigate the timing and method of data collection to ensure data reliability.

(2) **Coordination with Research Institutions**

Data collection and model construction should be done with due consideration to the opinions of the academe and the experts. The outputs of research organizations, such as the ADBI, the Civil Engineering Society, and the East Asian Society of Transport Science, should also be used to the maximum extent possible. In particular, data, like the industrial input-output tables, have been hardly produced by government organizations, even though a number of case studies have been conducted by government research institutions. These research data can be the foundation of the database and could be useful when and if updated and complemented by other data.

A valuable undertaking is the Japan Civil Engineering Society's hosting of a research activity. It has set up 5 separate working groups to work on: 1) Future scenario writing, 2) Flow forecast methodology, 3) Policy evaluation method, 4) Database construction, and 5) International economy and policy trend. Coordinated by the Strategic Research Committee on the International Transport Network, the research output is expected to be out by 2008.

(3) **Human Network in International Conferences and Training Programs**

By making use of international conferences organized by UNESCAP, ADB, and others, data can be obtained through public presentations and human networking. Data could also be gathered through trainees who attend a variety of training programs sponsored by JICA.

(4) **Technical Cooperation in Database Construction**

Items (1) – (3) mentioned above are examples of how to collect existing data. Future data collection aiming at database construction would require extending technical assistance to each country on data collection methods, database construction and maintenance and ensuring sustainable mechanism to follow up with its own initiative. Technical cooperation can be conducted through the establishment of a new training institution or a database center in addition to the JICA training programs which could include determining the need for databases and sharing them with neighboring countries, the methodology of data collection, and so on.

(5) **Research on Techniques to Complement Data**

Although it is not directly related to data collection and maintenance, the fact remains that not all data can be obtained for all the regions concerned. This problem was also experienced during the database construction for the CGEurope Model. To cope with this problem, the database was divided into 3 layers, namely EU, country, and region. The upper layer of data was used as control total to apply to the lower-layer data. It is believed that there are similar problems in the Greater Mekong Subregion. It is thus necessary to study the techniques that enable substitution of missing data.

6.6 Transport Demand Estimate in the Greater Mekong Subregion and Effect of CBTI on Regional Development (Trial Calculation)

By using data collected so far, transport demand in relation to CBTI development was estimated. It should be noted, however, that this estimate was based on some rough assumptions and hypotheses due to limited data availability and uncertain data accuracy.

In this trial estimate, population and GRDP by province were obtained from the official statistics of each country, while the OD tables and the transport network came from the ADB transport sector strategy study. The trial calculation is conducted for the present conditions in 2004 due to data availability.

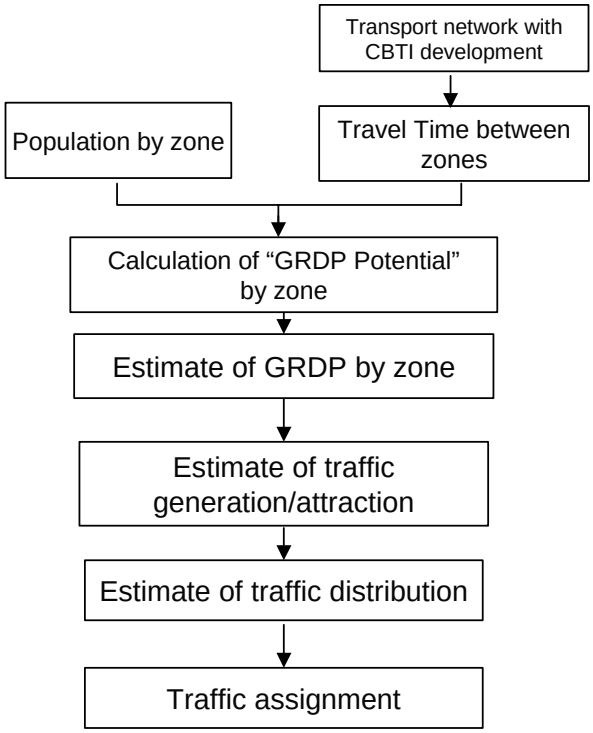
1) Traffic Demand Growth and Regional Development Impacts due to CBTI/CBTA Development

(1) Considerations to Demand Estimation

In this trial calculation, the impact of CBTI development was estimated by assuming that people in one area interact with those in other areas, thereby mutually influencing their respective socio-economies and cultures. This influence is latent and can be called the potential of the region. The potential increases when populations become larger and the distances between two areas shorten. In other words, the potential increases if travel time (time distance) decreases as a result of CBTI development. Higher potential results in the growth of the GRDP and traffic volumes. The process of this demand estimation is schematically illustrated in Figure 6.6.1.

As for zoning, the study area comprising 5 countries and some parts of China was divided into 190 zones according to the provincial boundaries of each country, as was done in the ADB transport sector strategy study. Zones outside the GMS and the ocean-going shipping lines were excluded just like in the ADB study.

Figure 6.6.1 Transport Demand Estimation with CBTI Development



(2) **Estimation Method**

GRDP Estimate

In order to estimate the GRDP, it was assumed that the potential grows as travel time shortens, as a result of CBTI development, and that zonal GRDP changes accordingly.

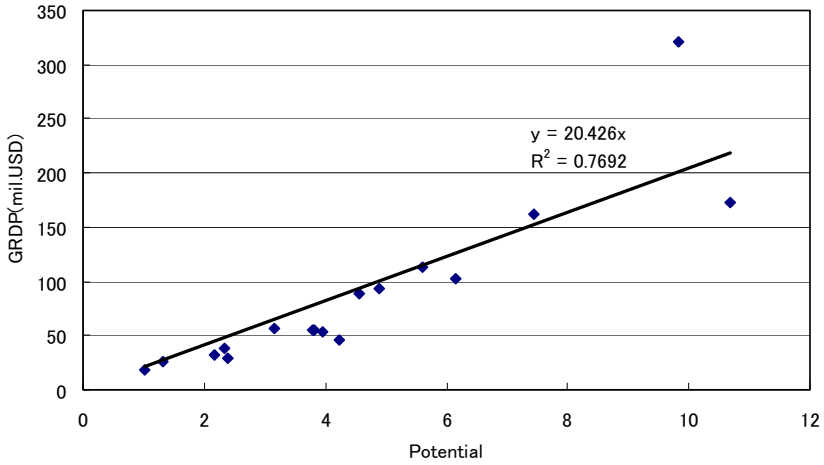
The potential of a zone could be expressed in the following formula:

$$P_i = \sum_n \frac{Pop^i \cdot Pop^j}{d_{ij}} \times 10^{-12} \qquad (1)$$

The advantage of zone i is proportionate to the population Pop^i in zone i and at the same time to the population Pop^j in its partner zone j. It is inversely proportionate to travel time d_{ij} (hour) between zone i and zone j. The potential of zone i is defined as the sum of these advantages for all partner zones. The growth of the potential is thus a result of shortened travel time between zones, which is brought about by CBTI development.

The interrelationship between the GRDP and its potential is almost linear, as exemplified in the figure below:

Figure 6.6.2 Relationship between GRDP and Its Potential in Lao PDR



Since the GRDP-potential interrelationship is markedly different by country, the respective GRDPs were estimated using a correction parameter calculated for each country. For a small number of zones deviating extremely from the average tendency, separate correction factors were applied.

The GRDPs were estimated using the following formula and parameters:

$$GRDP_i = \alpha \cdot P_i \qquad (2)$$

Country	Parameter
Lao PDR	20.426
Vietnam	10.163
Cambodia	17.704
Thailand	76.316
Myanmar	11.009
China	6.510

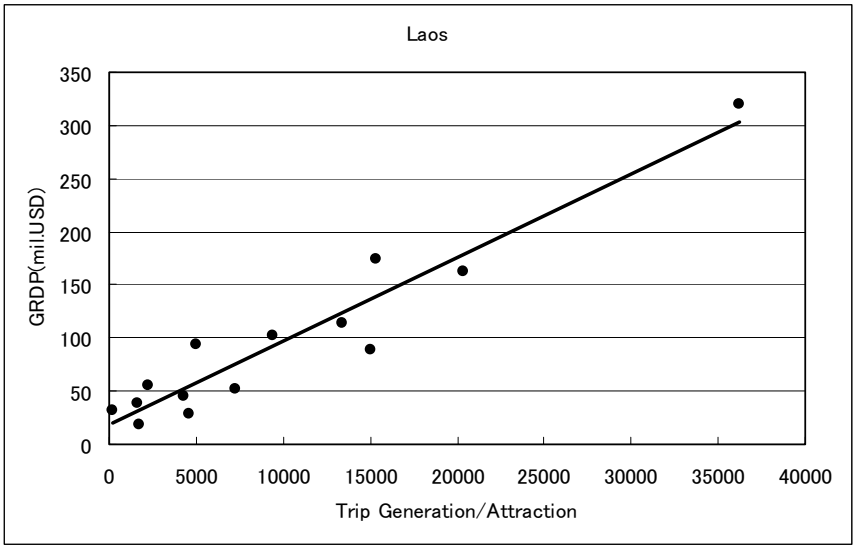
Estimate of Trip Generation/Attraction

The next step was to estimate generation/attraction of passenger and freight in each zone in the GMS.

The ADB transport sector strategy study classified passenger flow into OD tables of 5 modes: motorcycle, car, bus, railway, and inland waterway. Motorcycle use was limited to short-distance trips, and inland waterway was used only in some special areas since traffic volume is small. Thus, for these 2 modes, the present figures were taken without estimating the changes. Trip generation/attraction was estimated for the remaining 3 modes, namely car, bus, and railway. The current modal split shares of these 3 modes were also assumed. However, unlike in the ADB study, intrazonal traffic was not considered.

As for freight flow, the OD table consists of the 3 modes of truck, railway, and inland waterway. Although the freight flow by inland waterway is only between limited zones, the transported volume is large unlike the passenger volume. The total transport volumes in these 3 modes were estimated as the first step. Although the volumes of traffic generation and attraction tended to be generally different for freight, they are almost the same as a shown in the ADB study. Therefore, total generation and attraction volume was first estimated, then divided into generation and attraction using the current ratio of generation and attraction.

Figure 6.6.3 Relationship between Passenger Trip Generation/Attraction and GRDP for Lao PDR



As the relationship between trip generation/attraction and GRDP is almost linear as shown above, the GRDP was taken as an explanatory variable in the regressional equation. Such equation was prepared for each country using a correction factor, as was done in the GRDP estimate, to wit:

$$GA_i = \alpha + \beta \cdot GRDP_i \qquad (3)$$

The parameters by country are shown below.

Country	Passenger Traffic		Freight Traffic	
	α	β	α	β
Lao PDR	-1,193	115.61	2,331	77.30
Vietnam	105,846	189.76	62,652	169.78
Cambodia	0	143.22	3,118	26.43
Thailand	480,835	304.89	132,964	65.56
Myanmar	0	491.16	0	124.23
China	238,134	9.46	21,208	15.73

Trip Distribution

The Fratar method (present pattern method) was applied to estimate trip distribution. Although the gravity model may be suitable for estimating trip distribution to quantify the effect of completed CBTI, the present pattern method was instead adopted due to the lack of data.

While there are many zonal pairs set at zero in the OD tables, the zero was replaced by 1 in the OD tables when the Fratar method was used.

Traffic Assignment

This task assigns the traffic volume between zones onto the transport network. Unlike urban traffic, however, travel time between zones are very long and traffic congestions has little impact on modal choice. Therefore it is assumed that the minimum path in terms of the generalized cost shall be selected.

Traffic assignment was done using PCU (passenger car unit) after converting the passenger and freight flow using the average occupancy (passengers/PCU) and the average load (tons/PCU) as was done in the ADB study.

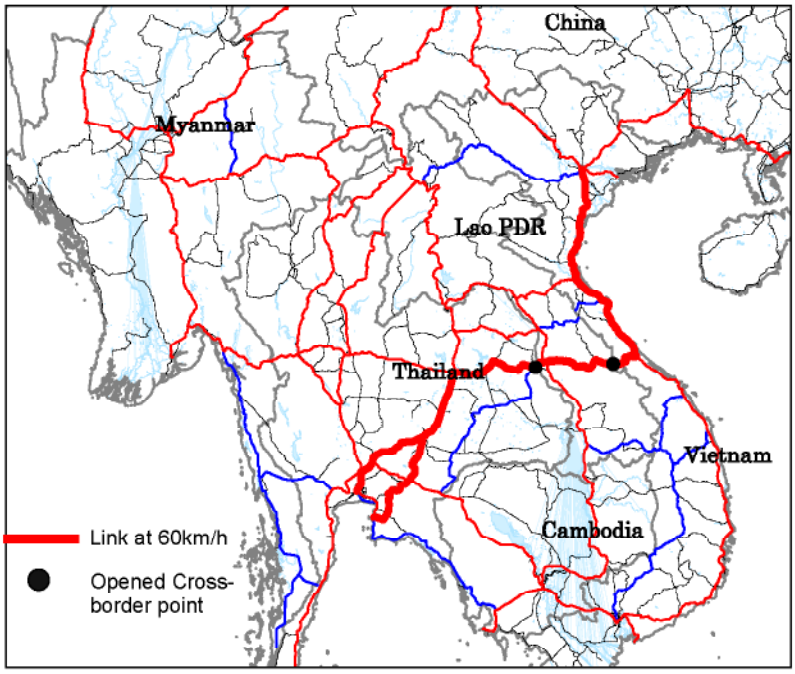
(3) Resulting Demand Estimates

Cases

Demand was estimated for 5 cases as explained below. "Development" means the lowest speed at 60km/h for the improved link (including cross-border point).

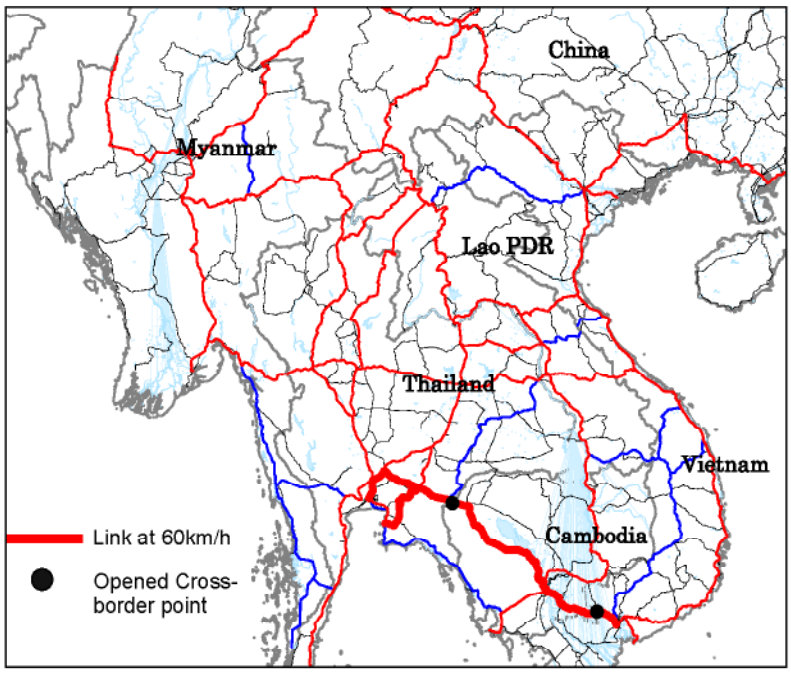
(a) CBTI development between Bangkok and Hanoi

Figure 6.6.4 (1) Demand Forecast Case 1



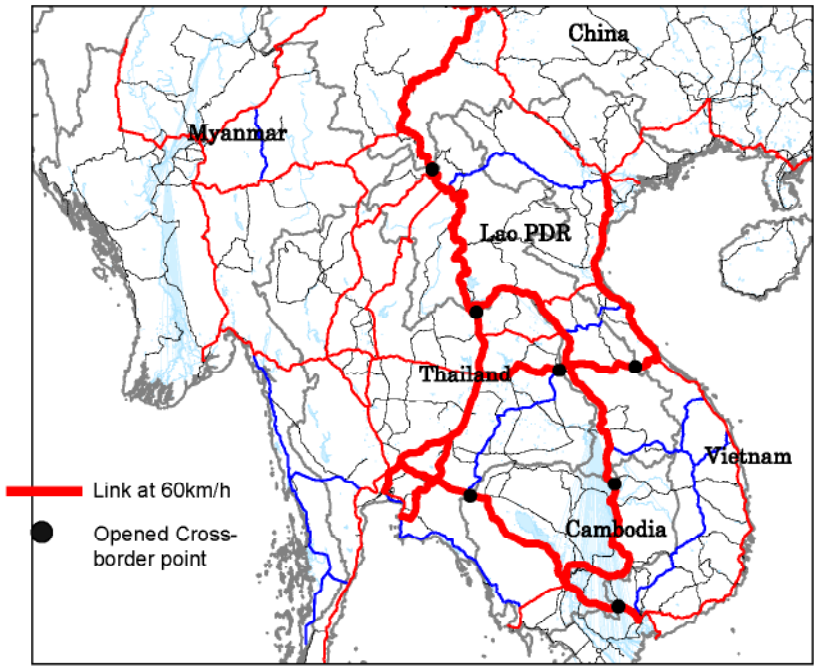
(b) CBTI development between Bangkok and Ho Chi Minh

Figure 6.6.4 (2) Demand Forecast Case 2



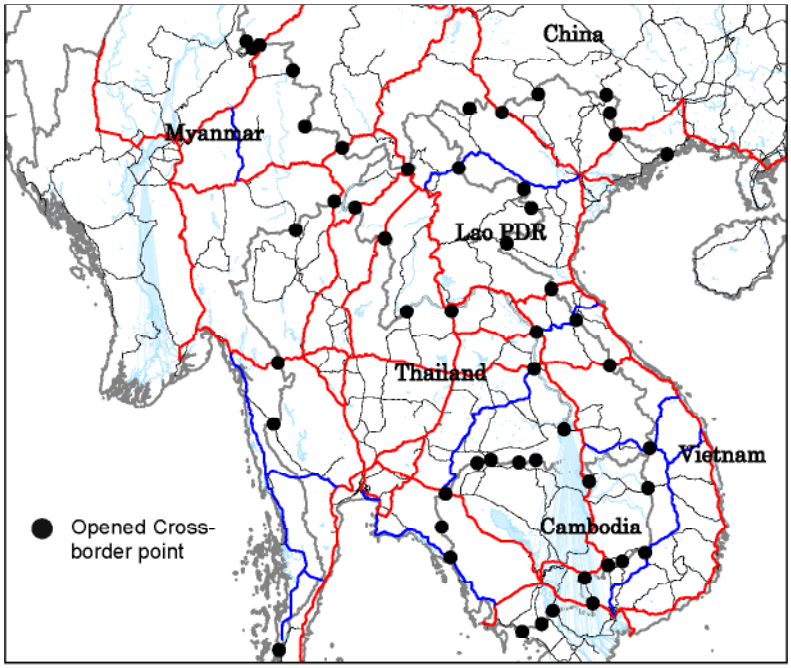
(c) CBTI development along the EW and NS economic corridors

Figure 6.6.4 (3) Demand Estimate Case 3



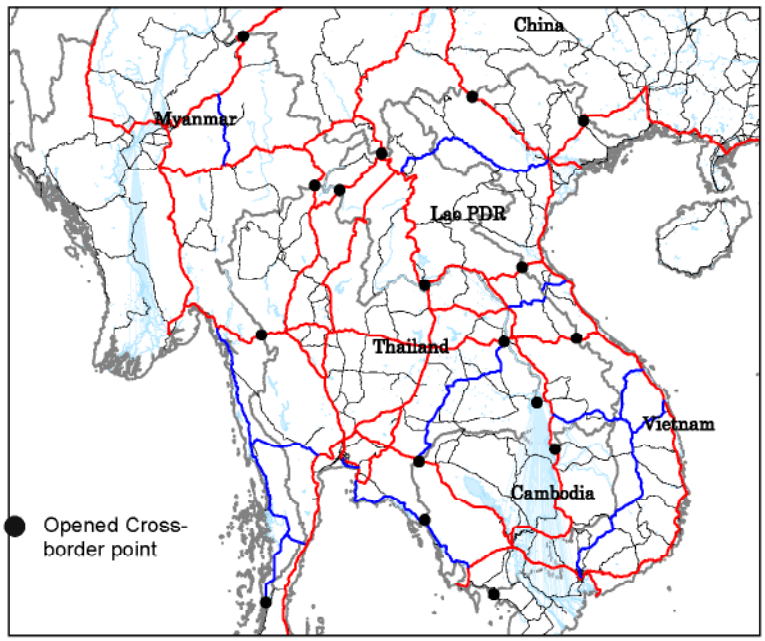
(d) Abolished border-crossing procedures in all cross-border points (no CBTI improvement)

Figure 6.6.4 (4) Demand Estimate Case 4



(e) 16 cross-border points passable within 30 minutes (with CBTA, but no CBTI improvement)

Figure 6.6.4 (5) Demand Estimate Case 5



Results of Estimate

(a) Changes in GRDP

The GRDP increased along with the increase of the potential, which was triggered in turn by the shortened travel time resulting from CBTI development. Table 6.6.1 shows the growth rates of GDP (total of GRDP) by country as compared to the present situation (Case 0: the do-nothing case).

This trial result delivers an important message: that it is highly possible for the GRDP (precisely GRDP Potential) to grow, when and if CBTI/CBTA are completed.

Table 6.6.1 Growth of GDP by Country (%)

	Case-1	Case-2	Case-3	Case-4	Case-5
Cambodia	102.4	155.7	226.5	249.9	237.1
Lao PDR	155.8	100.6	334.3	366.8	331.4
Myanmar	102.8	102.8	104.5	211.0	191.5
Thailand	123.5	119.1	181.6	197.7	189.4
Vietnam	108.1	110.2	137.7	210.9	204.1
China	100.2	100.1	101.7	104.5	104.1

As shown in the table above, the GDP growth rates of Cambodia and Lao PDR are remarkable, while those of China are minimal.

With regard to Case-1 and Case-2 wherein the corridors have improved, the GDP rates of Lao PDR and Cambodia grew sharply. In Case-4, which is based on an extreme assumption of a free cross-border traffic at border points within the Greater Mekong Subregion, all the countries except China grew more than twice (200%).

Case-5 shows an intermediate growth between Case-3 and Case-4, implying that "soft" infrastructure development (i.e. CBTA) may have a larger impact than "hard"