Istanbul Metropolitan Municipality
&
Japan International Cooperation Agency (JICA)

# THE STUDY ON INTEGRATED URBAN TRANSPORTATION MASTER PLAN FOR ISTANBUL METROPOLITAN AREA IN THE REPUBLIC OF TURKEY

## Technical Report

January 2009

ALMEC Corporation
Nippon Koei Co., Ltd

Exchange Rate used in the Report

(as of August 2008)

YTL 1.0 = US$ 0.86

= EU 0.64

= JY 92

| | |
|---|---|
| US$1.0 | = YTL 1.16 |
| EU 1.0 | = YTL 1.54 |
| JY 1000 | = YTL 10.9 |

## PREFACE

In response to a request from the Government of the Republic of Turkey, the Government of Japan decided to conduct "The Study on Integrated Urban Transport Master Plan for the Istanbul Metropolitan Area" and entrusted to the study to Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Tetsuo Wakui of ALMEC Co., LTD. And consists of ALMEC Co., LTD. And NIPPON KOEI Co., LTD. between June, 2007 and October, 2008.

The team held discussions with the officials concerned of the Government of the Republic of Turkey and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studied and prepared this final report.

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

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Turkey for their close cooperation extended to the study.

January, 2009

**EIJI HASHIMOTO,**
Vice President
Japan International Cooperation Agency

January 2009

HASHIMOTO Eiji
Vice President
Japan International Cooperation Agency
Tokyo

## Letter of Transmittal

Dear Sir,

We are pleased to formally submit herewith the final report of the Study on Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area In the Republic of Turkey.

This report compiles the result of the study which was undertaken both in Turkey and Japan from June 2007 to January 2009 by the Team comprising ALMEC Corporation and Nippon Koei Co., Ltd.

We owe a lot to many people for the accomplishment of this study. First we would like to express our sincere appreciation and deep gratitude to all those who extended their extensive assistance and cooperation to the Team, in particular the Steering Committee and composed by Istanbul Metropolitan Municipality.

We also acknowledge the officials of your agency, the JICA Advisory Committee, and the Embassy of Japan in Turkey to their support and valuable advise in the course of the Study.

We hope the report would contribute to the sustainable development of Istanbul.

Very truly yours,

**WAKUI Tetsuo**
Team Leader
Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area

**Technical Report for the Study on**
**Integrated Urban Transport Master Plan for**
**Istanbul Metropolitan Area**

Table of Contents

# Part 1 Demand Forecast

## 1.1 Introduction

In the Master Plan Study and the Pre-Feasibility Study in IUAP, traffic assignment was done by “User-Optimal Equilibrium Assign method” installed in “JICA-STRADA”. Originally, it was intended to use “TransCAD” following a normative procedure of: (1) Estimation of time among each OD pair in transit/highway networks (2) Calculation of modal share for each OD pair (3) Transit assignment and finally (4) Highway assignment. However, future transit network had not prepared by the time and then the said procedure was taken.

## 1.2 Four Step Model

TransCAD focuses basically not on daily transport demand but on peak-time demand which is estimated based on daily Production and Attraction. Figure1.2.1 shows the work flow.

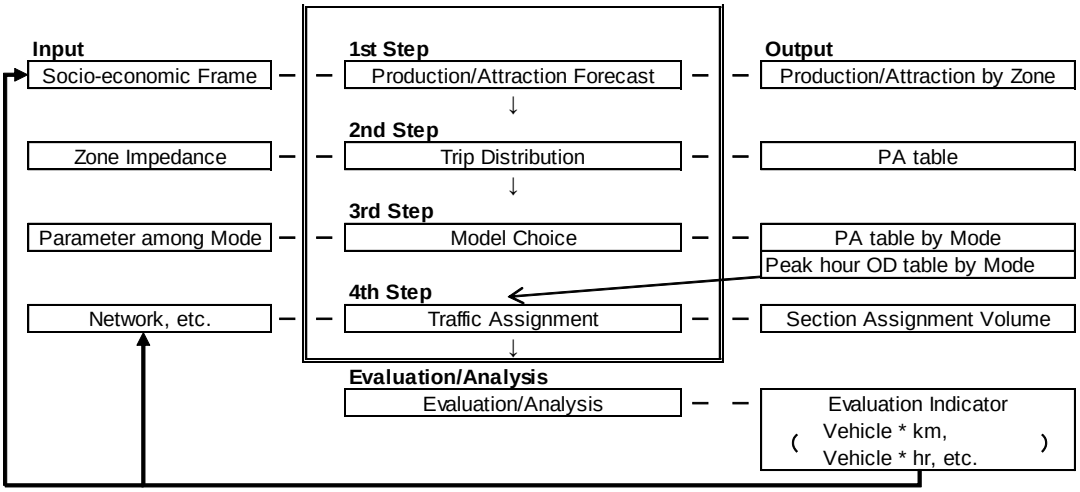


**Figure 1.2.1 Work Flow of Four Step Method**

Without using a control total for entire produced trips, summation of produced trips will make the number of total trips in the Study Area.

It should be noted that a PA matrix is not an OD matrix but represents trips to be, assuming that “One who goes from i zone to j zone must come back from j zone to i zone.” In case a component of ij is 100 trips, 50 trips, a half of 100 trips represent trips from zone i to zone j with a given purpose and the other half represent returning trips from zone j to zone i.

### 1.2.1 Production/Attraction Model

Production/Attraction model is to estimate the number of produced trips and attracted trips from/to each zone by trip purpose of work, school, home based others and non-home based trips.

Production and Attraction models were originally developed with TransCAD. The JICA Study Team developed a program named **MGA02.for/ MGA02.exe** in order to apply the P/A models apart from TransCAD.

The procedure to run the MGA02.for is as follows:

Step 1: Open an attached excel file of Socio-economic framework file named:
**SEco2006_and_2023-Senario-1.xlsx**
Step 2: Open a worksheet named **SEco.dat**, located at the left end.
Step 3: Input the year to calculate the P&A in **Cell A1**.
Step 4: Save the sheet as a text file with the name of **"SEco.dat"**
Step 5: Run MGA02.exe and it will output **MGA02.OUT** as a text file.

Four categories of trip purposes are as follows:

HBW: Home Base Work
HBS: Home Base School
HBO: Home Base Other
NHB: Non Home Base

**Table 1.2.1 Parameters of P&A Models**

| Trip Purpose | Gen/Att | Formula | | | | | |
|---|---|---|---|---|---|---|---|
| HBW | Production | Net Trip Rate (1.94) * Working Ratio (0.88) * No of Workers (Home Base) | | | | | |
| | Attraction | Net Trip Rate (1.94) * Working Ratio (0.88) * No of Employment (Work Place Base) | | | | | |
| HBS | Production | Net Trip Rate (2.02) * Studying Ratio (0.87) * No of Students (Home Base) | | | | | |
| | Attraction | Net Trip Rate (2.02) * Studying Ratio (0.87) * No of Students (School Place Base) | | | | | |
| | | Y=a+b1*X1+b2*X2+b3*X3+b4*X4+b5*X5 | | | | | |
| | | a | b1 | b2 | b3 | b4 | b5 |
| NBO | Production | -748.943 | 0.425737 | 1,163,230 | 0.558952 | | |
| | | Constant | Population | Average Income | Workers | | |
| | Attraction | 1,063,040 | 0.44342 | 0.290994 | 0.257524 | | |
| | | Constant | Population | Student at School | Employment | | |
| NHB | Production | 511,731 | 0.089921 | 0.296634 | | | |
| | | Constant | Student at School | Employment | | | |
| | Attraction | 464,118 | 0.015623 | 0.03754 | 0.286727 | | |
| | | Constant | Population | Student at School | Employment | | |
| | Control Total | -33,342 | 0.091362 | -0.0225442 | 0.426405 | 0.100278 | -0.00149 |
| | | Constant | Population | Student in Home | No. of Vehicle | Average Income | Employment |

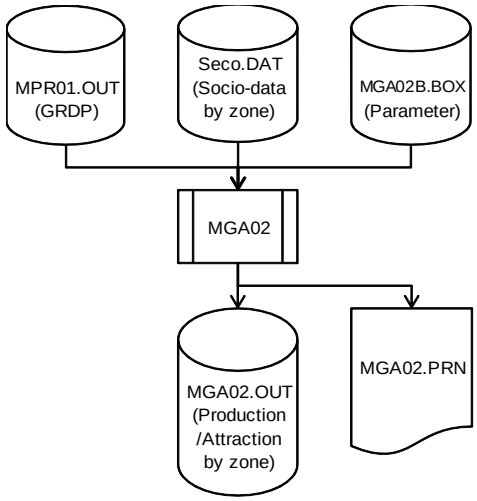


**Figure 1.2.2 Work Flow of Production and Attraction Model**

Output of the Model is not hourly but daily produced trips and attracted trips.

### 1.2.2 Trip Distribution Model

The Trip Distribution Models are to work out four PA Tables by trip purpose, using the following formula.

Tij = AiBj * [(PiAi) /dijb]

Notation

Tij = Trips from i to j in a specified amount of time (usually rush hour)

Ai = Constant to balance trips originating from TAZ i

Bj = Constant to balance trips destined for TAZ j

Pi = Total number of trips Originating in TAZ i

Ai = Total number of trips Destined for TAZ j

dij = distance from i to j

b = Power factor for discounting distance

**Table 1.2.2 Parameters of Trip Distribution Models**

| | HBW | HBS | HBO | NHB |
|---|---|---|---|---|
| **Beta** | 1.913 | 3.022 | 2.410 | 1.736 |

Using the same models and parameters, the JICA Study team prepared a program named **MTD03X2 for**, of which output was confirmed to coincide with that of TransCAD.

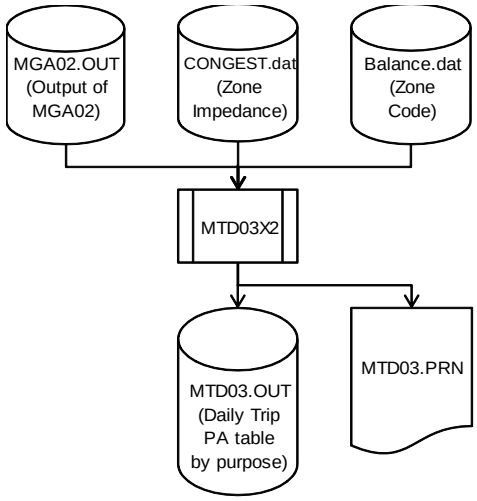


**Figure 1.2.3 I/O Flow of Trip Distribution Model**

Outputs are daily produced trips and attracted trips by purpose.

### 1.2.3 Modal Split Model

A multi-modal logit model with parameters shown in Table 1.2.3 was adopted for modal split

**Table1.2.3 Parameters of Modal Split Model**

| Logit Model Para-meter | Mode | Walk Const. | Car Const. | Service Const. | Public Const. | No of Car per Capita | House-hold In-come | Dist (km) | Time (min) | Travel Cost (YTL) | Bos-porus Dummy | Rail St. Dummy (Origin) | Rail St. Dummy (Dist) | Ferry Dummy (Origin) | Ferry Dummy (Dest.) | Intra Zone Dummy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HBW | Walk | | | | | | | -0.173 | -0.004 | | | | | | | 2.333 |
| | P.Car | | -1.814 | | | 7.651 | 0.081 | | -0.004 | -0.027 | -0.106 | | | | | |
| | Service | | | -1.018 | | | | | -0.004 | -0.027 | | | | | | |
| | Public | | | | -0.693 | | | | -0.004 | -0.027 | | 0.263 | 0.230 | 0.433 | 0.378 | |
| HBS | Walk | #### | | | | | | | -0.013 | | -0.569 | | | | | 2.441 |
| | P.Car | | | | | 5.371 | 0.342 | | -0.013 | -0.026 | | | | | | |
| | Service | | | 2.383 | | | | | -0.013 | -0.026 | | | | | | |
| | Public | | | | 2.374 | | | | -0.013 | -0.026 | | 0.225 | 0.175 | 0.550 | 0.516 | |
| HBO | Walk | | | | | | | -0.123 | -0.005 | | | | | | | 2.938 |
| | P.Car | | -1.983 | | | 6.296 | 0.123 | | -0.005 | -0.011 | -0.109 | | | | | |
| | Service | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Public | | | | -0.834 | | | | -0.005 | -0.011 | | 0.207 | 0.151 | 0.432 | 0.420 | |
| NHB | Walk | | | | | | | -0.073 | -0.010 | | | | | | | 2.337 |
| | P.Car | | -0.475 | | | 2.013 | 0.094 | | -0.010 | -0.020 | | | | | | |
| | Service | | | -2.041 | | | | | -0.010 | -0.020 | | | | | | |
| | Public | | | | -0.502 | | | | -0.010 | -0.020 | | 0.243 | 0.210 | 0.408 | 0.315 | |

Due to frequent changes of the parameters of modal split model, no Fortran program was made. The model is as of 1 of April, 2008. A dummy variable has not been applied to intra-zonal trips.

Output of the model is a daily PA Matrix.

### 1.2.4 Estimation of Peak-hour PA Matrix

This program is to convert a daily PA matrix to an hourly PA matrix. Generally, traffic assignment will not be done for one day, but for peak hours. Therefore, a daily PA matrix has to be converted to peak-hour PCU OD matrix by each trip purpose.

As an input data, peak-hour ratio is needed by trip purpose, by time band and by direction of “go” and “come back”. An attached file named HOURLY.xls should be referred to for detail.

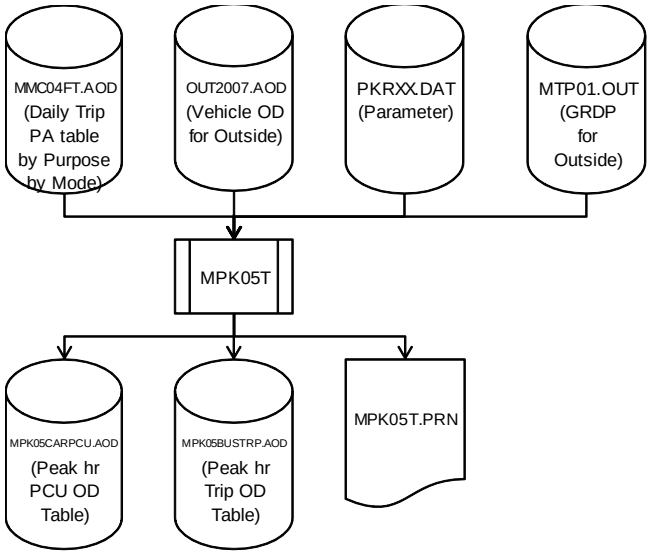


**Figure 1.2.4 I/O of Peak Hour OD Model**

It should be noted that the unit of output is different by mode. There are three OD matrices: (1) Car, (2) Service and (3) Public Transit. The matrices of car and service are expresses in pcu per peak-hour, while that of public transit is expressed in passengers per peak hour. This is because the first two (1 and 2) modes will be assigned on highway network and public transit (3) will be assigned on a transit network.

Another point is that 460 zones which is inclusive of nine external zones are applied to (1) and (2), while 451zones to (3).

The stated models and programs are saved in a folder of ” 1_Model”.

### 1.3 Conversion and Application of IMP Network

IMP Network was a detailed road network developed by an IMP Group headed by Mrs. Verna not necessarily for the purpose of traffic assignment. It was converted to JICA-STRADA format by taking the following steps.

Step 1 TransCAD does not use any code for node explicitly. However, JICA STRADA requires to define two nodes for each one link. Then, a code for one node was defined as six digit integer, the first three digits were zone number and the following three were sequential number.

In case of railways, each node number was added by 500,000 in order to distinguish railway nodes from others. If the first digit of a node is over 5, then the node is a railway node because the largest zone number is 465.

In case of Metro-bus links, each node number was added by Metro-bus line number (1 to 13) times 10,000,000. If a code is nine digit number, it is a Metro-bus node and thenumber of the first two digits shows the line number.

Step 2 TransCAD adopts the BPR equation for setting relation between capacity and velocity. The same BPR equation as in TransCAD was used also in JICA-STRADA, where the parameter of Alpha was 0.15 and Beta was 4.0.

The maximum velocity of a link (Vmax) was corresponded to the free flow speed and the maximum daily capacity (Qmax) was estimated at the hourly capacity divided by peak hour ratio of the link.

For the links of railways and metro-bus routes, the capacity and velocity equation (QV Equation) of type No.9 prepared in JICA-STRADA was used. The type No.9 has a pattern where the velocity is unchanged at the overall speed until reaching to the capacity and zero after the capacity.

The Original data form of the network developed by IMM is stored in an attached file of “**Legend_Network.xlsx**.

The JICA Study Team used a GIS application, “MapInfo” to manage a network due to the following reasons:

(1) The original network has a lot of intermediate points (dummy nodes) between adjacent intersections. There are about 1,300,000 nodes while the number of links is only 15,000. TransCAD enables a link to have intermediate points as many as a user wants. However, JICA-STRADA allows the user to make maximum three intermediate nodes in a link.

(2) The original network has a database including as many as 120 items.
(3) The original network is fairly large in size, having 15,000 links in 451 zones.
(4) The original network has the coordinate system called UTM North 35 zone, 1984

The network files converted to JICA-STRADA are saved in the folder of "**2 Network**" and if you want to modify a network using "MapInfo", you should refer to the file of "**2 READme.txt**" kept in the same folder.

## 1.4 Origin and Destination Matrix (OD Matrix)

The Study Team was provided by the Counterpart Team with daily person trip OD matrices of the year 2006 and 2023 by trip purpose and by mode (walk, car, service and public transport). The future OD matrices of 2023 was made for two cases of "Do Nothing" case and "Base Rail Network" case.

The OD matrices of the intermediate years of 2013 and 2018 were interpolated using attached program of "**OD-Target.exe**" and data of "**Pop-Year.DAT**".

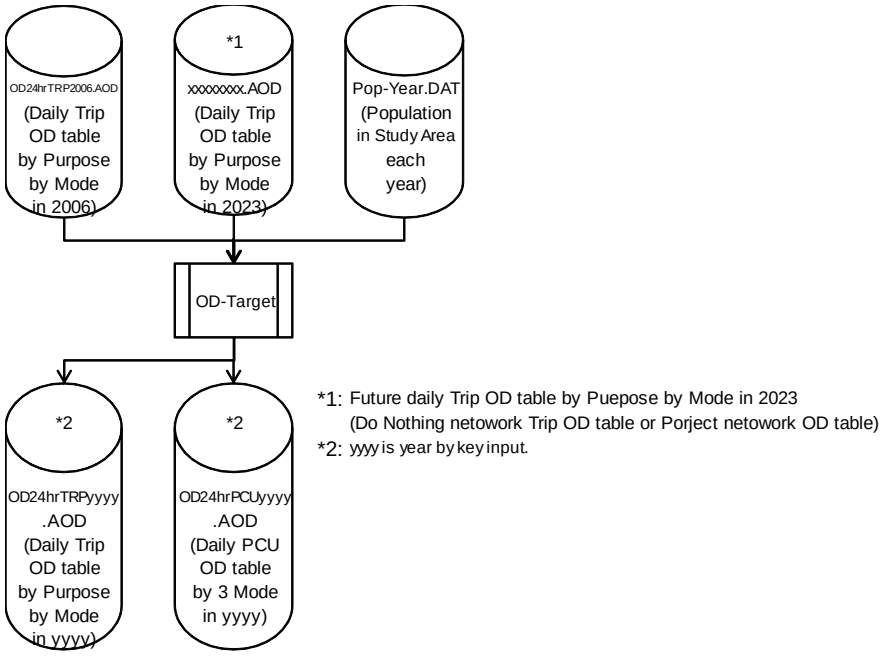


**Figure 1.4.1 Flow Chart for Development of OD Matrix of Intermediate Years**

OD matrices kept in the folders are as follows:

(1) OD24hrTRP2006.aod : Present Daily Trip OD Matrices by 4 purposes and by 4 modes
(2) OD24hrTRP2013.aod : Daily Trip OD Matrices of 2013 for Base Railway Network Case by 4 purposes and by 4 modes
(3) OD24hrTRP2018.aod : Daily Trip OD Matrices of 2018 for Base Railway Network Case by 4 purposes and by 4 modes
(4) OD24hrTRP2023_DNnet.aod : Daily Trip OD Matrices of 2023 for Do Nothing Network Case by 4 purposes and by 4 modes
(5) OD24hrTRP2023_DNRd_BasRl.aod : Daily Trip OD Matrices of 2023 for Base Railway

Network Case by 4 purposes and by 4 modes

Trip OD matrices listed above were further converted to PCU OD Matrix which were directly used for network assignment. The OCU OD matrices are as follows:

(6) OD24hrPCU2006.aod : Present Daily OD Matrices by 3 modes in terms of passenger car unit (PCU)
(7) OD24hrPCU2013.aod : Daily PCU OD Matrices of 2013 for Base Railway Network Case by 3 modes
(8) OD24hrPCU2018.aod : Daily PCU OD Matrices of 2018 for Base Railway Network Case by 3 modes
(9) OD24hrPCU2023_DNRd_BasRl.aod: Daily PCU OD Matrices of 2023 for Base Railway Network Case by 3 modes

The conversion from "Trip OD" to "PCU OD" assumed PCU conversion factor by mode and average occupancy (number of passengers) as shown in Table 1.4.1 and also shown in attached folder of **"PCU_and_Ave-Occ.xlsx"**.

**Table 1.4.1 PCU Conversion Factor and Average Occupancy**

| | Car | Service | Public Transport |
|---|---|---|---|
| PCU Conversion Factor | 1.0 | 2.0 | 3.0 |
| Average Occupancy | 1.57 | 10.0 | 30.4 |

Source: Transportation Research Group of IMP

OD Matrices following the JICA-STRADA's Format (*.AOD) are saved in the folder of **"3 OD"** which also includes programs and data for making "Desire Line Chart".

## 1.5 Traffic Demand Loading on Network by "User Optimum Equilibrium Assignment"

Future OD matrices have already been forecasted by mode, using modal split models. In usual process, every OD volume of public transportation passengers is loaded on public transport lines (of railway, bus and ship) by transit assignment for the first step and then every OD volume of cars and service vehicles is loaded on the road network with bus traffic preloaded already.

In this study, however, the normative process stated above was not taken. Instead, All OD volumes of car, service and bus are loaded on a network, at one time by using the user-optimum equilibrium assignment method installed in the JICA-STRADA, instead of using a transit assignment method. This assumes a ubiquitous bus route in the Study area, where a passenger can take any route without a transfer.

The reasons why not using a transit assignment are:

1. Transit assignment network has been under development and not yet applicable for practical use.
2. Present bus routes are not applicable with no change, to the future demand in a future network with a lot of railway lines.
3. The taken method is suitable to analyze the demand for bus services and develop a bus network configuration for the future.

In the taken method, the followings are assumed and pre-conditioned:

1. Cars and service vehicles are not allowed to take a railway lines.

2. Cars and service vehicles are allowed to take selected ferry service routes.
3. A rail transit is operated at a constant speed regardless the demand size lower than its capacity and after the demand exceeds the capacity, the operating speed becomes zero.
   - 45 km/hr for the Marmaray and its extension
   - 20km/hr for a tram line
   - 35km/ hr for others

- Only cars can pass the Marmaray road tunnel.
- Operating speed of a passenger ferry and a car ferry is assumed at 5km/hr.
- Daily capacity of an ordinary road is 800 pcu/ lane/ hour.
- No fare is charged on public transport, assuming the same fare system for bus, rail and ferry.
- No fare was charged on a car crossing the Bosporus because of no alternatives.
- External traffic demand is ignored.
- Capacities of railway are set in terms of pcu. Passengers can take a train only at a station. No transfer penalty was considered.

It is noted that the iteration was terminated when the relative error reached less than 0.01% for every link.

### 1.5.1 Assignment Method

The JICA-STRADA has a module installed of the user optimum equilibrium assignment. The operational procedure is as follows.

(1) To boot up the User Optimum Equilibrium Assignment of STRADA 3.5

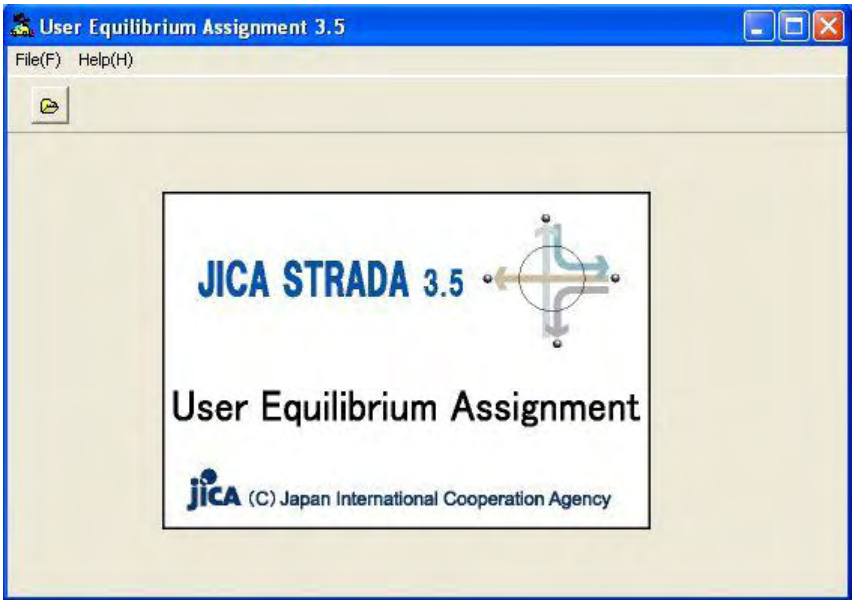


**Figure 1.5.1 Opening Window of User Optimum Equilibrium Assignment**

(2) To Specify I/O files

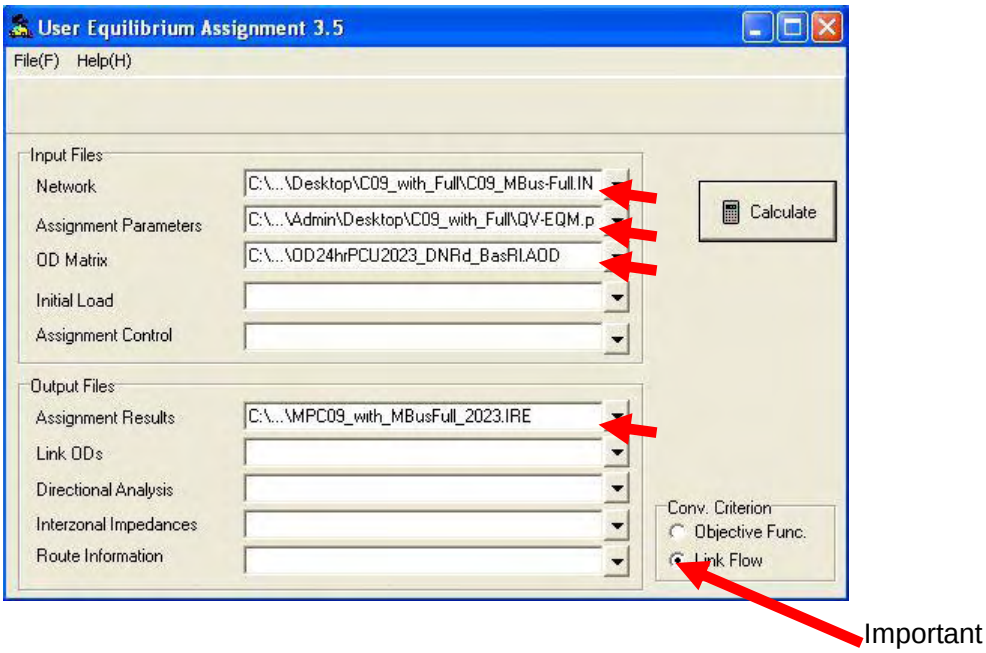


**Figure 1.5.2 Window of Specifying I/O files**

Here, completion of iteration was judged by link flow and then “link flow” located at the bottom to the right of the window was clicked.

(3) To start iterative calculation

After specifying necessary I/O files, push the “calculation” button at the upper right of the window to start calculation. In most cases, calculation is over after one to one and a half hour with 35 to 40 times iteration.

### 1.5.2 Master Plan

In the Study, the following nine networks were aimed at planning and evaluating for formulating the master plan network. Here, all the master plan projects were classified into three categories according to their priority:

Category A: Projects to be completed by the year of 2013

Category B: Projects to be completed by the year of 2018

Category C: Projects to be completed by the year of 2023

Case 1: Road Network in 2013 (Base Network + Category A Road Projects)
Case 2: Railway Network in 2013 (Base Network + Category A Railway Projects)
Case 3: Complete Network in 2013 (Base Network + Category A All Projects)
Case 4: Road Network in 2018 (Case 3 Network + Category B Road Projects)
Case 5: Railway Network in 2018 (Case 3 Network + Category B Railway Projects)
Case 6: Complete Network in 2018 (Case 3 Network + Category B All Projects)
Case 7: Road Network in 2023 (Case 6 Network + Category C Road Projects)
Case 8: Railway Network in 2023 (case 6 Network + Category C Road Projects)
Case 9: Complete Network in 2023 (case 6 Network + Category C All Projects)

Actually, there were no railway projects classified to the category A and consequently Case 2 Network and Case 3 Network are the same one as Case 1 Network. For each case of Case 1 to Case 9 (except Case 2 and Case 3), input files, assignment result files,

VOC/TTC and demand for the projects were stored in the appendix DVD.

### 1.5.3 Pre-Feasibility Study

Projects of metro-bus extension and a railway are selected for pre-feasibility study. demand assignment was done for each project in the benchmark years. In case of the railway project, the line was doubled to simulate a double tracked railway, in order to obtain data necessary for making an operation plan.

**(1) Pre-Feasibility Study for Railway Project**

**Assignment of Daily Demand on Single Track Railway**

(Refer to page 17-1 of Chapter 17 of the main text as for Alternatives)

1. Alternative 1 in 2011
2. Alternative 2 in 2011
3. Alternative 3 in 2011
4. Alternative 4 in 2011
5. Alternative 1 in 2023
6. Alternative 2 in 2023
7. Alternative 3 in 2023
8. Alternative 4 in 2023
9. Alternative 2 in 2011 (PP-2)
10. Alternative 2 in 2011 (PP-1 + PP-2)
11. Alternative 2 in 2011 (P2-1)
12. Alternative 2 in 2011 (PP-1 + PP-2 + P2-1)

**Assignment of Daily Demand on Double Track Railway**

After Alternative 2 was selected as the most desirable one, the following cases were analyzed to develop an operational plan for the best alternative.

1. Alternative 2 in 2021 (PP-2)
2. Alternative 2 in 2021 (PP-1 + PP-2)
3. Alternative 2 in 2022 (P2-1)
4. Alternative 2 in 2022 (PP-1 + PP-2 + P2-1)
5. Alternative 2 in 2023 (PP-1 + PP-2 + P2-1)

**Assignment of Peak-Time Demand on Double Track Railway**

Overall peak-time ratio of 12.15% was used to convert the daily OD matrix to the peak-time OD matrix.

6. Alternative 2 in 2021 (PP-2)
7. Alternative 2 in 2021 (PP-1 + PP-2)
8. Alternative 2 in 2022 (P2-1)
9. Alternative 2 in 2022 (PP-1 + PP-2 + P2-1)
10. Alternative 2 in 2023 (PP-1 + PP-2 + P2-1)

**(2) Pre-Feasibility Study for Metro-Bus Extension**

Two metro-bus lines (M-01 and M-02) are already under operation and one line of M-03 is under construction. In this Study, six projects of M-04, M-06, M-07, M-08, M-12 and M-13 were examined. The last four projects of M-07 to M-13 are extensions of M-04. Five cases were set up by their combination:

1. Base case of projects under operation/ construction of M-01 toM-03
2. Base case plus M-08

3. Base case plus M-04 and M-07
4. Base case plus M-06, M-12 and M-13
5. Base case plus all the projects of M-04, M-06, M-07, M-08, M-12 and M-13

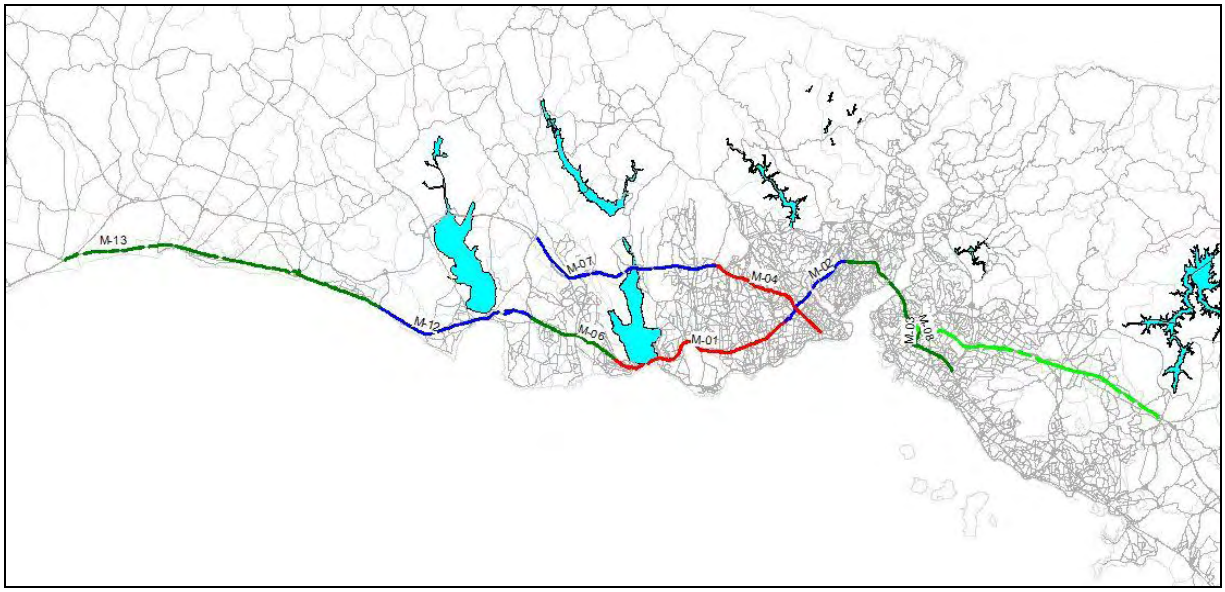


**Figure 1.5.3 Future Metro-Bus Route**

The following 15 cases of assignment were done for the metro-bus pre feasibility study:

1. M-01, M-02 and M-03 in 2013
2. M-01, M-02, M-03 and M-08 in 2013
3. M-01, M-02, M-03, M-04 and M-07 in 2013
4. M-01, M-02, M-03, M-06, M-12 and M-13 in 2013
5. M-01, M-02, M-03, M-04, M-06, M-07, M-08, M-12 and M-13 in 2013
6. M-01, M-02 and M-03 in 2018
7. M-01, M-02, M-03 and M-08 in 2018
8. M-01, M-02, M-03, M-04 and M-07 in 2018
9. M-01, M-02, M-03, M-06, M-12 and M-13 in 2018
10. M-01, M-02, M-03, M-04, M-06, M-07, M-08, M-12 and M-13 in 2018
11. M-01, M-02 and M-03 in 2023
12. M-01, M-02, M-03 and M-08 in 2023
13. M-01, M-02, M-03, M-04 and M-07 in 2023
14. M-01, M-02, M-03, M-06, M-12 and M-13 in 2023
15. M-01, M-02, M-03, M-04, M-06, M-07, M-08, M-12 and M-13 in 2023

### 1.5.4 TDM (Transport Demand Management)

The Appendix DVD stores following assignment files concerning the transportation demand management (TDM) projects.

(1) Provided 20% of passenger car users shift to public transport mode, what will be the impact of the modal shift on the traffic and economic aspects in case of Master Plan Case 09 in 2023.

(2) In the same way as above, case of 40% shift was analyzed.

(3) Congestion charge on expressway in case of YTL 0.25, 0.50, 0.75 and 1.00 per km, respectively.

### 1.5.5 Drawing of Assignment Results

IMP made a network with 15,000 links and 1,300,000 nodes and consequently there are more than 1,200,000 nodes not on the end of the links but intermediate of the links, while the JICA STRADA network (***.INT Files**) allows each link to have maximum three intermediate points.

By the reason above, a traffic flow diagram made by the JICA-STRADA will occasionally give an impression different from the same diagram made by the TransCAD. In order to avoid this inconvenience, a program named "**ASSireV-WidMIF_U4U.exe**" was prepared. By the program, intermediate points (nodes) of an original network made by the TransCAD are incorporated in the traffic flow diagram drawn by using the JICA-STRADA.

A typical network named "**NET.MIF/NET.MID**" is required as an input of the intermediate points. After running the program, the following data is needed to input:

(1) To input the file name of assignment result by the JICA-STRADA

(2) To specify a transport mode to draw by a code number ( in this Study, 1: Car 2: Service 3: Public, 11 All modes)

(3) Scale of traffic flow band (F10.0)

(4) Threshold minimum traffic to draw (F10.0)

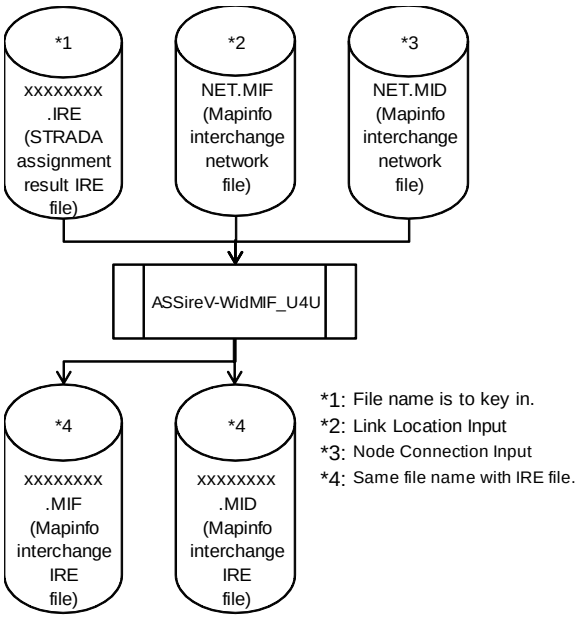


**Figure 1.5.4 Drawing Procedure of Assignment Result**

There are two output files with the same name as the input assignment result file (*.IRE) and extensions of MID and MIF. Those two files have to be imported by a GIS application software of "MapInfo".

NET.MID/MIF files are different by the input network size and then they are prepared under the name of "**NETxxxx.MID/MIF**" for each of Master Plan, Pre-FS and others. Before using the conversion program, proper networks should be selected and renamed to "**NET.MID/MIF**". If any link in the *.IRE file is not found, the coordinates of the two nodes of

the link are used without inserting intermediate points.

It should be noted that the NET.MID/MIF files are unavoidable even they are null-object.

### 1.5.6 Calculation of Vehicle Operating Cost (VOC) and Travel Time Cost(TTC)

In this Study, economic benefit of a project is defined as the reduction of transport cost which is composed of vehicle operating cost (VOC) and travel time cost (TTC). The former includes the operating cost of vehicles, railways and vessels. Details will be explained in Part 3 of this technical report.

Input of VOC/TTC calculation is an assignment result (*.IRE file) and transport cost is exported in a format of CSV file, which is importable by "**Excel**". In order to run this module, it is necessary to run "CST.BAT" on the DOS System as seen in Figure 4.5.

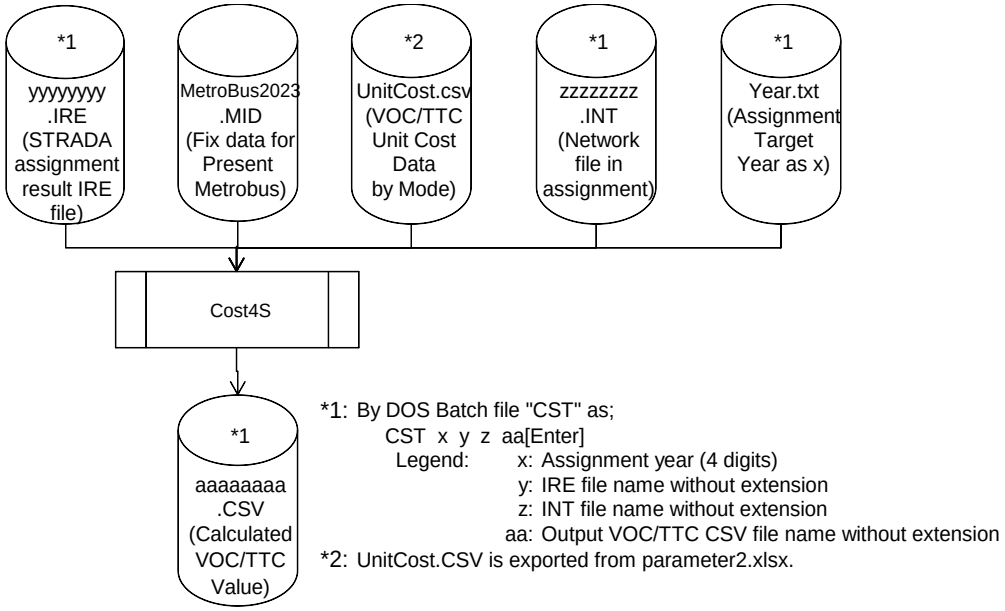


**Figure1.5.5 Input/Output of VOC/TTC Calculation Program**

Input/Output files of the User Optimum Equilibrium Assignment done by the JICA-STRADA are stored in the folder of "4 User Equilibrium Assignment by case.

## 1.6 Map Data

IMM/IMP are developing and keeping a lot of map information and database in the form of ESRI shape files and its convertible forms. They use the metric coordinate system of North Zone 35 settled n 1984 of **the Universal Transverse Mercator (UTM)**

The IMM Directorate of Transportation Planning and IMP Transportation Group use TransCAD as a transportation demand management application which adopts the same coordinate system for such mapping data as zoning and networks.

On the other hand, other applications of Mapinfo and JICA-STRADA cannot use the UTM coordinate system and adopt **the Longitude/ Latitude Coordinate System**.

The Study Team collected and used the following maps.

1. Topographic map with contours of 10m interval.
2. Zone centroid map of 33 integrated zones
3. Zone boundary map of 33 integrated zones including zone-wise socio-economic data.
4. Zone centroid map of 451 integrated zones
5. Zone boundary map of 451 integrated zones including zone-wise socio-economic data.
6. Road network more detail than networks for traffic assignment but without link data.
7. District boundary map
8. Lake and pond map
9. Screen line map including screen survey stations
10. Coastal line map
11. 33 integrated zone map and 451 zone map in the JICA-STRADA format

The Mapinfo/ JICA-STRADA have a zone numbering system from 1 to 460 of which 1 to 451 are zones in the Study Area and 452 to 460 are outer zones.

On the other hand, the TransCad has a six digit zone numbering system of xyyzzz, where x takes a value of “3” meaning that the zone belongs to the European side or “9” to the Asian side, yy takes a value of “01” to “33” which stands for the integrated zone number and zzz takes a value of “001” to “453” which stands for the zone number (there are two skipped number).

Map files for MapInfo are stored in the folder of “5 Map”.

## 1.7 Land Use Data

In the IUAP Study, future socio-economic framework has been discussed long time in relation to the future land use plan. Finally, future population of the Study Area was set at 16 million as the target.

The data and map concerning to the land use and socio-economic data used in the Study are as follows:

1. Present land use map
2. Future Land use plan (2023)
3. Legend of land use in English
4. Socio-economic framework in 2023
5. Population projected to year 2025
6. Area by land use by Mahalle
7. Location of school at present
8. Present average income
9. Area of employment concentration
10. Population by zone

Files concerning to land use and socio-economic data are stored in the folder of “6. land use”.

## 1.8 Materials for Friday Meetings

During the Study, regular Friday Meetings were held to make a brief presentation on weekly progress. Materials and contents are as follows.

(1) 20070719_Progress_and_Working-Plan (The first eight digits stand for the date of meeting.)

Process and work plan for demand forecast were explained. Data collection and results of some preliminary analysis were presented including present desire line charts by trip

purpose.

(2) 20070727_Network-Conversion_and_PA (GA) model (1)

How to convert TransCAD data to JICA-STRADA data was explained including how to treat “node” information. Fitness of the trip generation and attraction model in Fortran version was reported and there was a big discrepancy between the results of Fortran model and TransCAD, especially in Non-home based trips. It was pointed out that the gap was due to the demand from/to hotels and later it was revised.

(3) 20070803_Bosporus-crossing-Demand_and_PAmodel (2)

Firstly, as a part of analysis on the present land use, relationship between employment (at living place base) and workers (at working place base) was reported. Secondly, a desire line chart of traffic demand crossing the Bosporus Strait was presented and thirdly, it was reported that re-building of trip generation and attraction had been completed.

(4) 20070810_Europe_Asia_Demand_and Modal Choice Model

Classifying all the present trips into three groups of trips moving inside the European area, trips inside the Asian area and the trips crossing the Bosporus, trips from Asia to Europe and trips from Europe to Asia are remarkably imbalanced.

Re-built modal split model in Fortran was reported to work well and its output is similar to that of the TransCAD.

(5) 20070816_STRADA_Instruction_and_Demonstration

How to use JICA-STRADA was explained with demonstration of the following modules:

11. Matrix Manipulator
12. Network Editor
13. Network Editor
14. Incremental Assignment
15. User Equilibrium Assignment
16. Highway Reporter

Differences between TransCAD and JICA-STRADA were especially highlighted.

(6) 20070817_TripDistributionModel_and_Conversion_to_STRADA

It was reported that the re-built trip distribution model by purpose was successfully translated in Fortran. In addition, data conversion from TransCAD to JICA-STRADA was reported about its progress and schedule.

(7) 20071005_MP-Benefit_and_Progress

Program to calculate economic benefit was explained together with project ranking.

(8) 20080208_ScreenVolume_Between_CountingModel_and_IMP-Model

Fitness of demand forecast model was reported by comparing traffic volume crossing screen lines and estimates by model. It was revealed that future household income rise would increase car ownership and by this the share of private car would become larger. Improvement of road network would accelerate this tendency. Expansion of railway network would also enlarge the share of public transport passengers, Consequently, “walk” trip and “service vehicle” would lose their shares.

(9) 20080215_IMP-Modal-Choice-Model2_and_theResult

Performance of improved modal split model with dummy variables for railway station, port and the Bosporus was explained and gaps between present estimates and model value of traffic volume crossing screen lines were presented.

(10) 20080222_TripDistributionModel-Consider_and_Capacity-Demand_GAP

It was found that the modal split model could not estimate well the traffic demand crossing the Bosporus and then, was re-built. The re-built model has a dummy variable as the exponent.

(11) 20080530_Model_Result_and_PreFS

The final version of demand forecast models were presented with its performance. In addition, necessary input such as future car ownership and household income were explained. Candidate projects for pre-feasibility study were presented and discussed.

(12) 20080613_DoMaxCalculation-Process

Road and railway projects in the “Do maximum” network were discussed to demarcate the committed or already approved projects to compose the base network. The base network will literally be the base of project evaluation. In addition, basic policy for future bus rerouting was discussed after expansion of the rail network and the metrobus network.

(13) 20080620_Intra-Zonal_Trip

The 451 zoning system has characteristics that zones in the CBD area are small in size and larger in the suburbs. At present, the suburban area has small population and then generated trips and attracted trips are not significant. In the future, however, the present suburban area would be fully urbanized. After urbanization reached the suburbs, the intra-zonal trip would become much larger. The JICA Study team emphasized that this scenario should be incorporated in the demand forecast.

(14) 20080627_about_Future_Bus_Rerouting

Basic idea of bus rerouting was presented as well as a material (12) 20080613_DoMax Calculation-Process.

(15) 20080723_MP_Demand_Forecast

Three cases of traffic assignments which are important preparatory works for the Master Plan formulation were explained. They are:

- Do Nothing Case in 2023
- Base Case in 2023
- Do Maximum Case in 2023

Results include traffic volume, congestion rate (Q/C ratio), Congested road length.

(16) 20080912_TransCAD-STRADA_All_or_Nothing_Comparison

Assigned traffic volume of “Do Maximum case” by TransCAD and JICA-STRADA were compared. They meet with allowable gaps.

Files of Friday meeting materials are stored in the folder of “6 CPmeeting”.